

Distribution of Cook Inlet Beluga Whales (*Delphinapterus leucas*) in Winter



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OCS Study
MMS 99-0024

Final Report

**Distribution of Cook Inlet
Beluga Whales (*Delphinapterus leucas*)
in Winter**

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Abstract

Beluga whales (*Delphinapterus leucas*) commonly occur in Cook Inlet during summer and autumn (May through October). However, little information is available on their distribution during the winter. Ten aerial surveys were conducted in Cook Inlet from 12 February through 14 March 1997. Some surveys were extended to include the lower Kenai Peninsula, Shelikof Strait, Kodiak Island, and Yakutat Bay areas. Most of the survey effort was devoted to search surveys along and within about 3 km of coastlines; however, sets of parallel transects were flown in Cook Inlet, Kamishak Bay, and Yakutat Bay. A total of 160 individual beluga whale sightings were recorded during 9,406 km of survey effort. Of these sightings, 150 were recorded in the middle portion of Cook Inlet, from the west side of Kalgin Island to just north of the East Foreland, and 10 were recorded near the Hubbard Glacier in Yakutat Bay (60°01' N, 139°35' W). The surveys also recorded four other species of cetacea (harbor porpoise, *Phocoena phocoena*, 35 individuals; Dall's porpoise, *Phocoenoides dalli*, 11 individuals; killer whale, *Orcinus orca*, 3 individuals; and fin whale, *Balaenoptera physalus*, 3 individuals), two species of pinnipedia (Steller's sea-lion, *Eumetopias jubatus*, 594 individuals; harbor seal, *Phoca vitulina*, 440 individuals), and sea otter (*Enhydra lutris*, 784 individuals).

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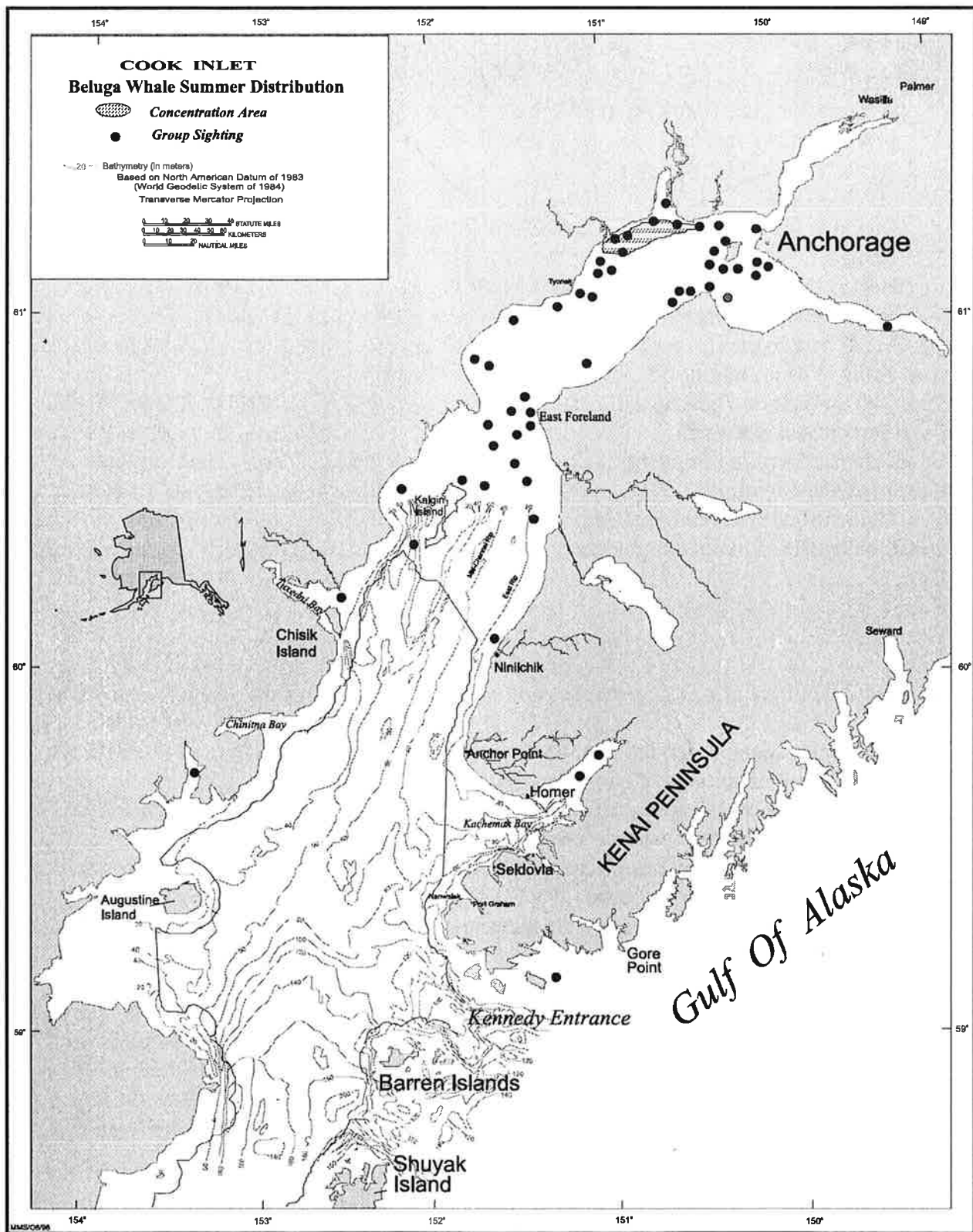


Figure 1. Historic Summer Distribution of Beluga Whale Sightings and Concentration area in Cook Inlet (Sources: Calkins, 1984; Rugh et al., 1995; NMFS, Marine Mammal Platforms of Opportunity Sightings Data, 1996.)

I. INTRODUCTION

The Cook Inlet population of belugas is believed to be geographically isolated from other Alaskan populations of this species that occur in the Bering, Chukchi, and Beaufort Seas (Calkins, 1989; Hill, DeMaster, and Small, 1996; Small and DeMaster, 1995).

The population currently is estimated at a mean of 505 animals (Hobbs, Rugh, and DeMaster, 1998), apparently having declined from an estimated 653 to 347 between 1994 and 1998 (Hobbs et al., 1998). Summer aerial surveys conducted by the National Marine Fisheries Service to determine whale population size found that seasonal concentrations of whales in the summer occur along the north coast of the upper inlet from the Beluga River east to and including the Susitna and Little Susitna Rivers, Knik Arm, and Chickaloon Bay (Rugh et al., 1995; Figure 1). Sightings of belugas formerly were common throughout the inlet during summer and fall (Calkins, 1989), but current indications are that the distribution has contracted (Rugh, 1998). The whales are believed to use the lower inlet more heavily during winter (Calkins, 1989); however, the distribution and abundance of beluga whales during winter (November through March) essentially is unknown (Calkins, 1989). The only previously documented presence of belugas in the study area during winter, four sightings on the west side of Cook Inlet, is shown in Figure 2 (Harrison and Hall, 1978; Agler et al., 1995). The National Marine Fisheries Service has commenced a status review of the Cook Inlet population to determine if there is a basis for listing this stock in a protected status (NMFS, 1999a), and to obtain data essential for its management and conservation (NMFS, 1999b).

Information on the occurrence of Cook Inlet beluga whales in all seasons is needed to address concerns about the potential effect of oil and gas development and other activities on this declining population. The paucity of Cook Inlet beluga sightings in winter prompted us to conduct aerial surveys of the Cook Inlet region in February and March during the period of maximum ice coverage in the inlet to determine their distribution and relative abundance in several areas where they had been previously reported or observed (Hansen and Hubbard, 1998).

II. STUDY AREA

The study area included Cook Inlet south to the latitude of Cape Douglas ($58^{\circ} 51' \text{ N.}$) and east to the longitude of Gore Point ($152^{\circ} 57' 30'' \text{ W.}$) and adjacent waters (Figure 2). Areas farther south to Kodiak Island and Shelikof Strait and east to Yakutat Bay were surveyed after interviews with subsistence whalers, fishermen, and government field personnel indicated belugas could occur in these areas, or had been reported (Appendix A).

Winter weather patterns in southcentral Alaska and the northern Gulf of Alaska are dominated by a low-pressure center over the western Aleutian Islands, with storm systems moving from west to east an average of every 4 to 5 days (Hartmann, 1974). Prevailing winter winds flow from the north-northeast in the Cook Inlet area, channeled parallel to the major inlet axis by surrounding mountain ranges, and from either direction at the level of Kamishak Bay and Kennedy-Stevenson Entrances (Brower et al., 1988). This regime is influenced by westerly mountain-gap

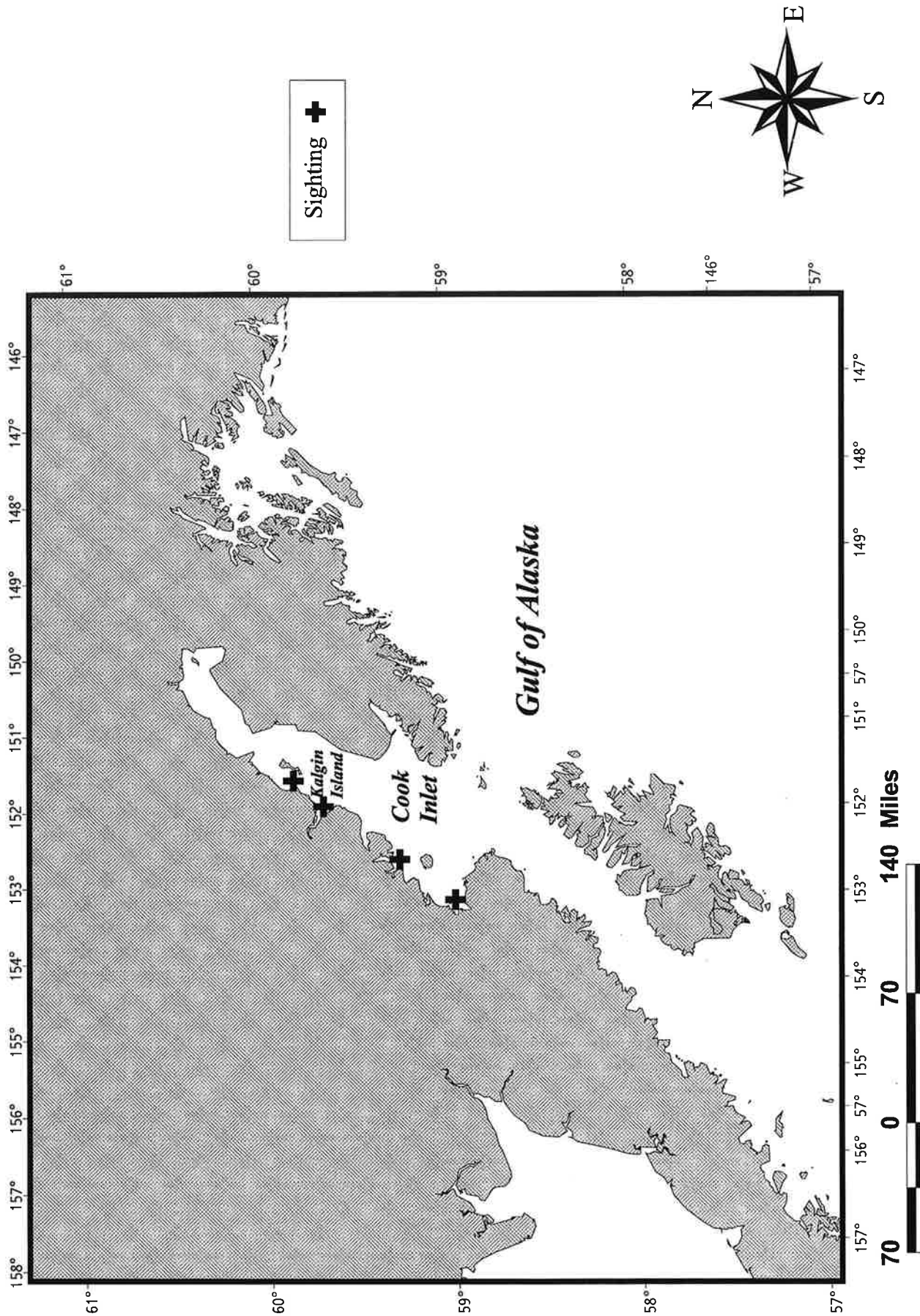


Figure 2. Map of Primary Study Area for Winter Surveys in Cook Inlet Area 12 February to 14 March 1997 and Historic Winter (November-March) Sightings of Belugas in Cook Inlet (Sources: Harrison and Hall, 1978; Agler et al., 1995).

winds through ranges on the Alaska Peninsula, and cold-air drainage from any of the surrounding mountains.

Circulation in Cook Inlet is produced by a complex interaction of the Alaska Coastal Current entering from the gulf, freshwater discharge from major rivers, and tidal oscillations, modified by upwelling and convergence of water masses (Muench, Mofjeld, and Charnell, 1978). Primary outflow is to Shelikof Strait. Tidal range in Cook Inlet is extreme—lows ranged from -4.6 to -7.6 feet and highs from 12.2 to 22.1 feet (Seldovia) during the project period. Sea ice in Cook Inlet generally reaches a maximum in late February (Brower et al., 1988).

III. MATERIALS AND METHODS

A. Objectives:

The objectives of the surveys were to:

1. Summarize from existing sources the known winter distribution and abundance of beluga whales in Cook Inlet.
2. Determine the distribution of beluga whales in Cook Inlet during winter, mapping the locations of whales sighted and identifying any concentration areas.
3. Record behaviors of beluga whales wintering in Cook Inlet, and prevailing environmental conditions where whales are found.
4. Record incidental sightings of other marine mammal species during the surveys.

B. Equipment:

The project aircraft was a de Havilland Twin Otter Series 300 equipped with bubble windows for complete trackline viewing. Onboard equipment and procedures replicated those developed and used in past years (1979-1997) for the Bowhead Whale Aerial Survey Program, described in Treacy (1996). Observers, data recorder, and pilot were linked to a common communication system with recording capability. Aircraft avionics included a Flight Management System (FMS) by ARNAV Systems, Inc., part of which is a Global Positioning System (GPS). The FMS 5000, Model GPS-505, is a worldwide satellite-based system that provides continuous position updating (15-m precision) and survey navigation through preprogramming of transect start and end points. GPS data are polled every 5 minutes for automatic input of time, latitude, longitude, and altitude.

A laptop computer (Compaq LTE 386) was used aboard the aircraft to store and analyze flight and observation data. A portable printer (Kodak Diconix 150 Plus Inkjet) was used to print a backup hard copy of all logged data.

Onboard safety equipment included an impact-triggered emergency locator transmitter (ELT) installed in the aircraft, a portable ELT in a 6-person Switlik Search and Rescue Life Raft, a portable aircraft-band transceiver, flotation suits, Nomex flight suits, and emergency crash helmets.

Table 1. Data-Entry Sequence on the Portable Flight Computer.

Sequence	Position Update	Beluga Whale Sightings	Other Cetacean Sightings	Other Species
1. Entry number	X	X	X	X
2. Time	X	X	X	X
3. Latitude	X	X	X	X
4. Longitude	X	X	X	X
5. Altitude	X	X	X	X
6. Reason for entry	X	X	X	X
7. Search type	X	X	X	X
8. Species		X	X	X
9. Sighting cue		X		
10. Habitat		X	X	X
11. Behavior		X	X	X
12. Size		X		
13. Total number		X	X	X
14. Calf number		X	X	X
15. Clinometer angle		X		
16. Side of plane		X		
17. Swim direction		X	X	
18. Swim speed		X		
19. Aircraft response		X	X	X
20. Repeat sighting		X		
21. Observer		X	X	
22. Weather	X	X	X	X
23. Visibility right	X	X	X	X
24. Visibility left	X	X	X	X
25. Ice coverage	X	X	X	X
26. Ice type	X	X	X	X
27. Sea state	X	X	X	X
28. Water color	X	X	X	X

Table 2. Operational Definitions of Observed Whale Behaviors.

Behavior	Definition
Swimming	Whale(s) proceeding forward through the water propelled by tail pushes.
Milling	Whale(s) swimming slowly at the surface in close proximity (within 100 m) to other whales, often with varying headings.
Diving	Whale(s) changing swim direction or body orientation relative to the water surface, resulting in submergence; may or may not be accompanied by lifting the tail out of the water.
Resting	Whale(s) floating at the surface with head, or head and back, exposed, showing no movement.
Feeding	Whale(s) diving repeatedly in a fixed general area.
Playing	Whale(s) milling or thrashing about.
Mating	Ventral-ventral orienting of two whales; other individuals may participate.
Cow-Calf	Calf nursing; calf swimming within 20 m of an adult.
Rolling	Whale(s) rotating on longitudinal axis, sometimes associated with mating.
Tail-slapping	Whale(s) floating horizontally or head-downward in the water, waving tail back and forth above the water and striking the water surface.
Underwater Blowing	Whale(s) exhaling while submerged, thus creating a visible bubble.

Survey observers used hand-held clinometers to determine the angle of inclination to the sighting location of observed whales. Written field notes complemented observations verbally relayed to the data recorder for entry into the computer.

C. Survey Design:

The aerial surveys were based in Anchorage, Alaska. The Minerals Management Service Principal Investigators and survey team conducted 8 days of aerial surveys in the Cook Inlet area and 2 days in the Yakutat Bay area during the period mid-February to mid-March 1997. The surveys were flown during daylight hours when sea states were favorable ($< \text{Beaufort } 5$) and ceilings were $\geq 1,000 \text{ ft}$ (304.8 m). The basic survey team included 4 observers: a team leader, who made decisions on daily survey protocol, a data recorder/observer, and 2 primary observers.

Survey locations and routes depended on the following factors:

1. Weather conditions—ceilings (VFR) and wind speed ($< 15 \text{ knots}$).
2. Locations of previous and current winter beluga sightings, which were used to plan surveys and routes to and from each day's survey area.
3. Patterns of ice coverage observed in transit to and from survey areas.
4. Presence of ice-free coastlines which were surveyed 1–2 km offshore.
5. Occurrence of favorable weather conditions allowing predetermined transects to be completed.

The primary objective of this study was to determine winter distribution of beluga whales in Cook Inlet. Beluga behaviors and basic information concerning other species incidentally sighted (e.g., other cetaceans, pinnipeds, sea otters) also were recorded.

D. Survey Protocol:

The basic personnel configuration on surveys consisted of a pilot, a team leader in the copilot seat, a starboard data recorder/observer, and a primary observer on each side of the aircraft.

The target altitude was a minimum of 1,000 ft (304.8 m) in order to avoid having to get an incidental-take permit from the National Marine Fisheries Service under the Marine Mammal Protection Act. Surveys over open water followed shorelines or predetermined routes or transects. Surveys over ice-covered areas (upper Cook Inlet) generally followed the ice edge, and also overflowed any substantial openings in the ice.

When we encountered whales, the aircraft was sometimes diverted from a predetermined path for brief periods ($\leq 10 \text{ min.}$) to circle the whales for better estimates of their numbers, to determine if sub-adults were present, and to record behaviors.

Coordination and consultation with the State of Alaska, Federal agencies, Native subsistence groups, commercial fishermen, and private companies for information on beluga whales in Cook Inlet and in the Gulf of Alaska consisted primarily of telephone conversations and personal interviews. Appendix A provides a list of contacts.

Table 3. Beluga Whale Aerial Survey Effort and Sighting Rates.

Flight #	Date	Total Hours	Total Km	Belugas Observed	Belugas /hour	Belugas /100 Km
1	12 Feb	3.95	828	12	3.04	1.45
2	15 Feb	3.1	605	0	0	0
3	19 Feb	3.38	759	10	2.95	1.32
4	20 Feb	1.3	474	0	0	0
5	28 Feb	6.42	1320	50	7.79	3.79
6	1 March	3.52	827	34	9.66	4.11
7	3 March	6.06	1254	0	0	0
8	12 March	5.53	1022	24	4.34	2.35
9	13 March	5.95	1169	11	1.85	0.94
10	14 March	5.63	1148	19	3.37	1.66
Totals		44.84	9406	160	$\bar{x} = 3.57$	$\bar{x} = 1.70$

Table 4. Selected Aerial Survey Data Recorded for Each Beluga Whale Sighting.

Flight No.	Latitude	Longitude	Adults	Heading (°)	Behavior	Speed
1	60.21.3	152.09.5	12	360	swim	medium
3	60.01.9	139.33.1	5		mill	
	60.01.9	139.32.2	5	90	swim	medium
5	60.30.2	152.01.5	36		mill	
	60.50.2	151.08.0	13	300	dive	medium
	60.31.5	151.53.3	1		rest	slow
6	60.30.0	152.00.2	12	10	swim	medium
	60.29.7	151.47.0	22	30	swim	medium
8	60.38.1	151.39.8	24	210	swim	slow
9	60.31.8	152.05.4	11	120	swim	medium
10	60.47.9	151.18.0	10	30	swim	slow
	60.31.4	151.59.0	9	20	swim	medium

Table 5. Proportion of Belugas Engaged in Specified Behaviors When First Sighted.

Behavior	Proportion (%)
Swimming, medium speed	44
Swimming, slow speed	21
Milling	27
Diving	8
Resting	1

E. Data-Entry Protocol:

Where appropriate, data-entry protocol followed procedures established for the Minerals Management Service Bowhead Whale Aerial Survey Project (Treacy, 1996). Basic data recorded for each whale or group of whales observed included time, location (latitude, longitude), number of individuals, clinometer angle (for calculation of distance of individual from trackline), visibility (distance), ice coverage (percentage), sea state (Beaufort scale), and behavior. Data-entry sequence on the flight computer for each observation is given on Table 1. Clinometer angle measurements were made when the initial sighting location was abeam the aircraft. Typical behaviors include swimming (with estimate of direction and speed), milling, resting, diving, and feeding. Operational definitions for whale behaviors are given on Table 2.

F. Data Analysis:

The distribution and relative abundance of beluga whales in Cook Inlet during the winter was determined from the project surveys. Whale distribution was compared to seasonal ice coverage.

Preliminary data analysis included editing flight data files and confirming summary values for sightings. Sighting rates for each flight were derived as number of belugas counted per unit of effort (per hour of survey and per kilometer) (Table 3).

Excel spreadsheets were prepared for flight data associated with sightings of beluga whales and other marine mammals. These spreadsheets list the latitude, longitude, and number of animals observed for each sighting. These data were converted into dbf files and imported into ArcView as tables. The tables were converted into event themes to allow portrayal of sightings on ArcView maps.

ArcView graphics software was used to plot daily flight maps of the track lines and positions of belugas recorded during each flight. These flight maps and narratives are given in Appendix B.

IV. RESULTS

A. Survey Effort:

A total of 9,406 km (44.84 hours) of aerial surveys were conducted between 12 February 1997 and 14 March 1997 in Cook Inlet and in the Gulf of Alaska searching for beluga whales (Table 3; Figures 3a and 3b). Eight surveys were conducted in Cook Inlet, with some of these surveys extending into Shelikof Strait and the bays of Kodiak Island, Afognak Island, and the lower Kenai Peninsula. Yakutat Bay was surveyed, as were limited portions of Prince William Sound and the Gulf of Alaska coast between Anchorage and Yakutat. Most flight effort was devoted to search surveys within about 3 km of shorelines. Sets of transects were flown across Cook Inlet and Yakutat Bay (Figures 3a and 3b).

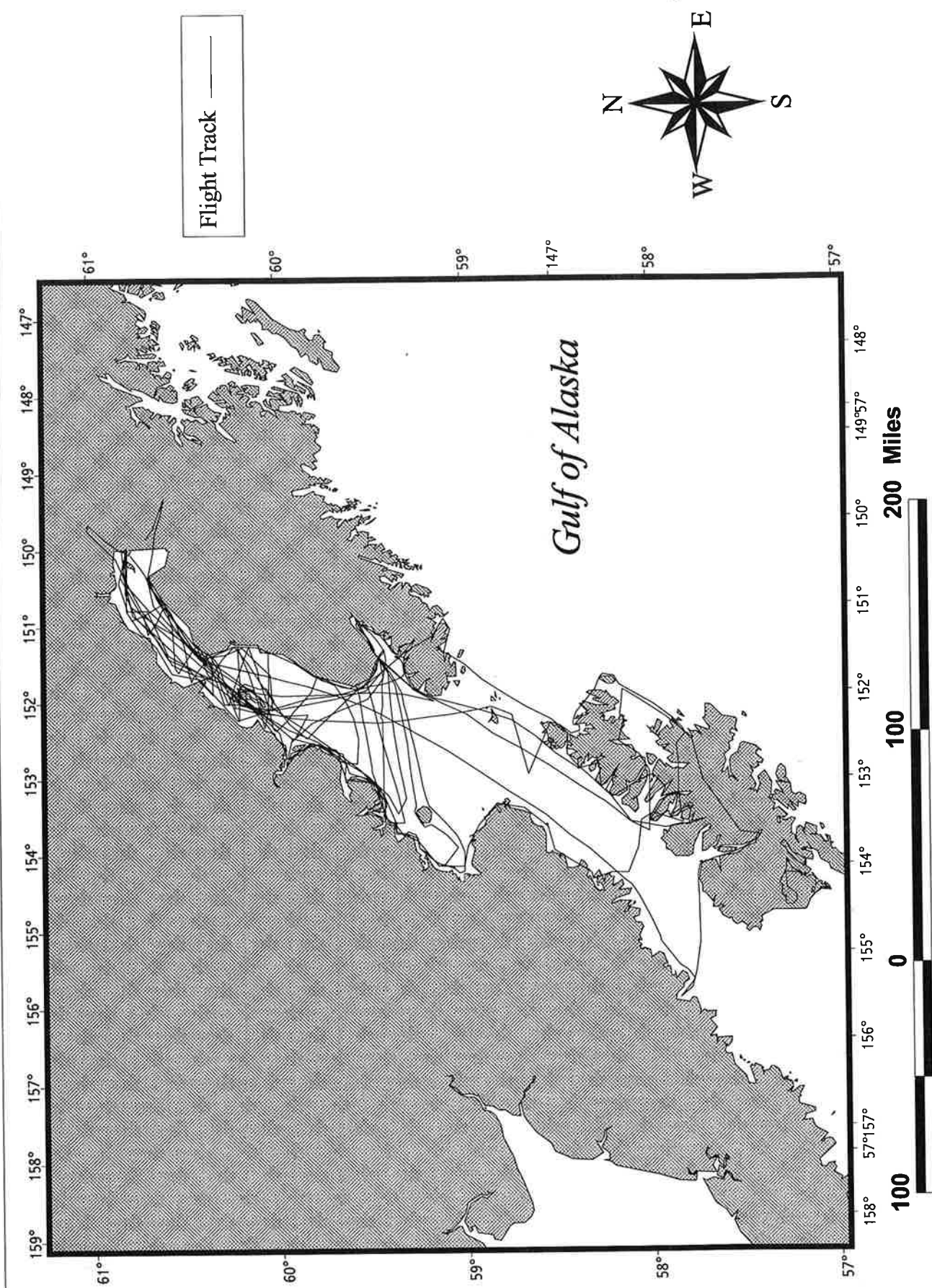


Figure 3a. Map of Beluga Whale Aerial Survey Flight Tracks in the Cook Inlet Area.

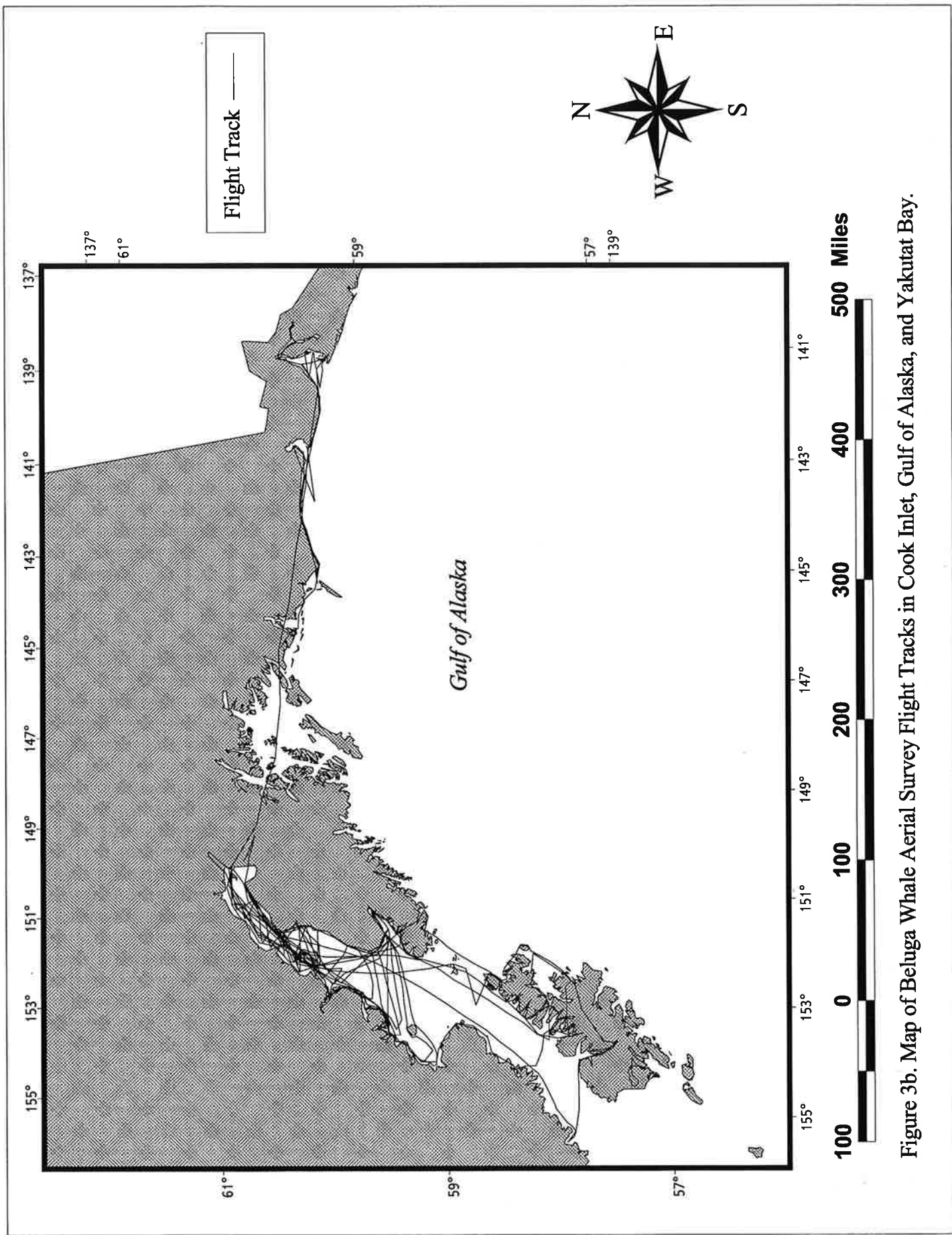
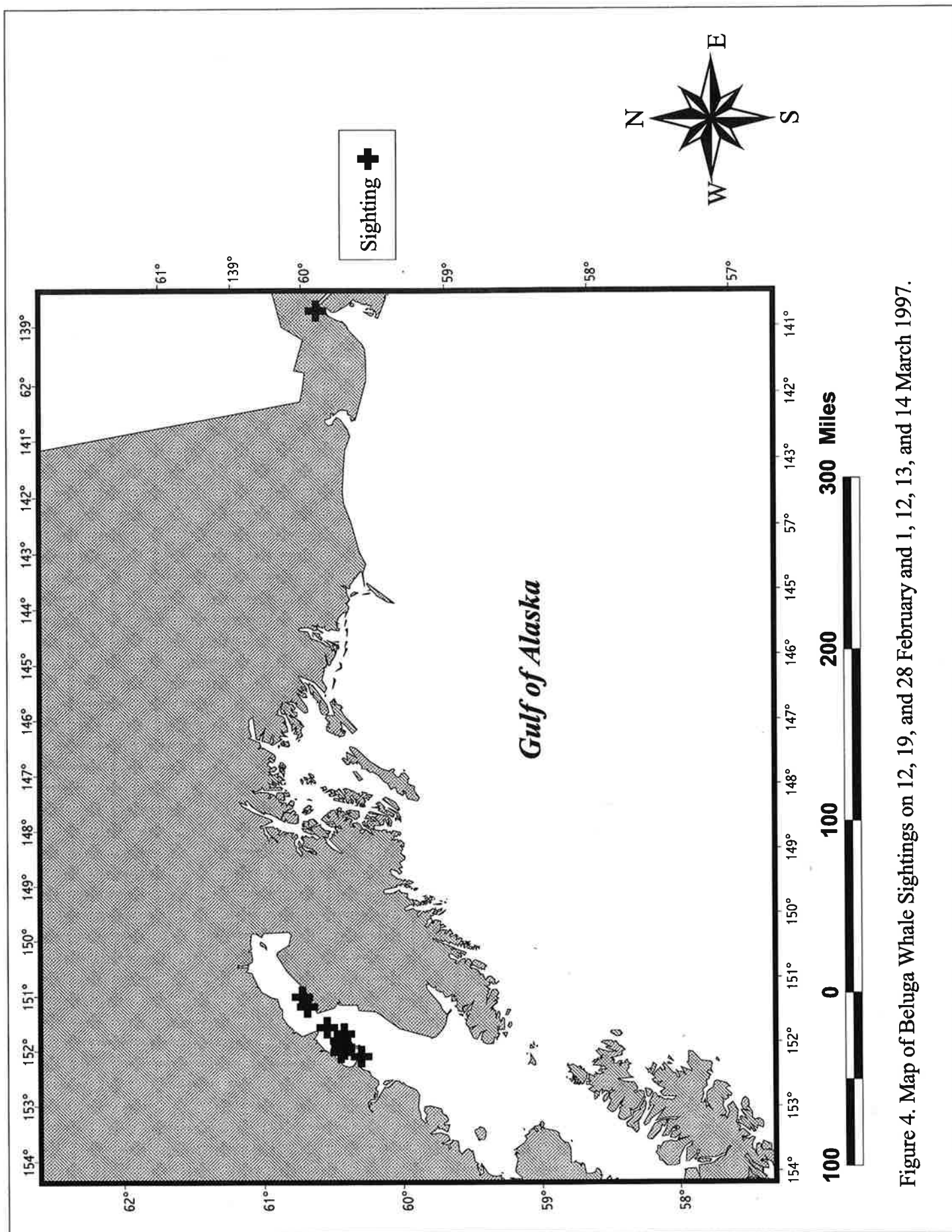


Figure 3b. Map of Beluga Whale Aerial Survey Flight Tracks in Cook Inlet, Gulf of Alaska, and Yakutat Bay.



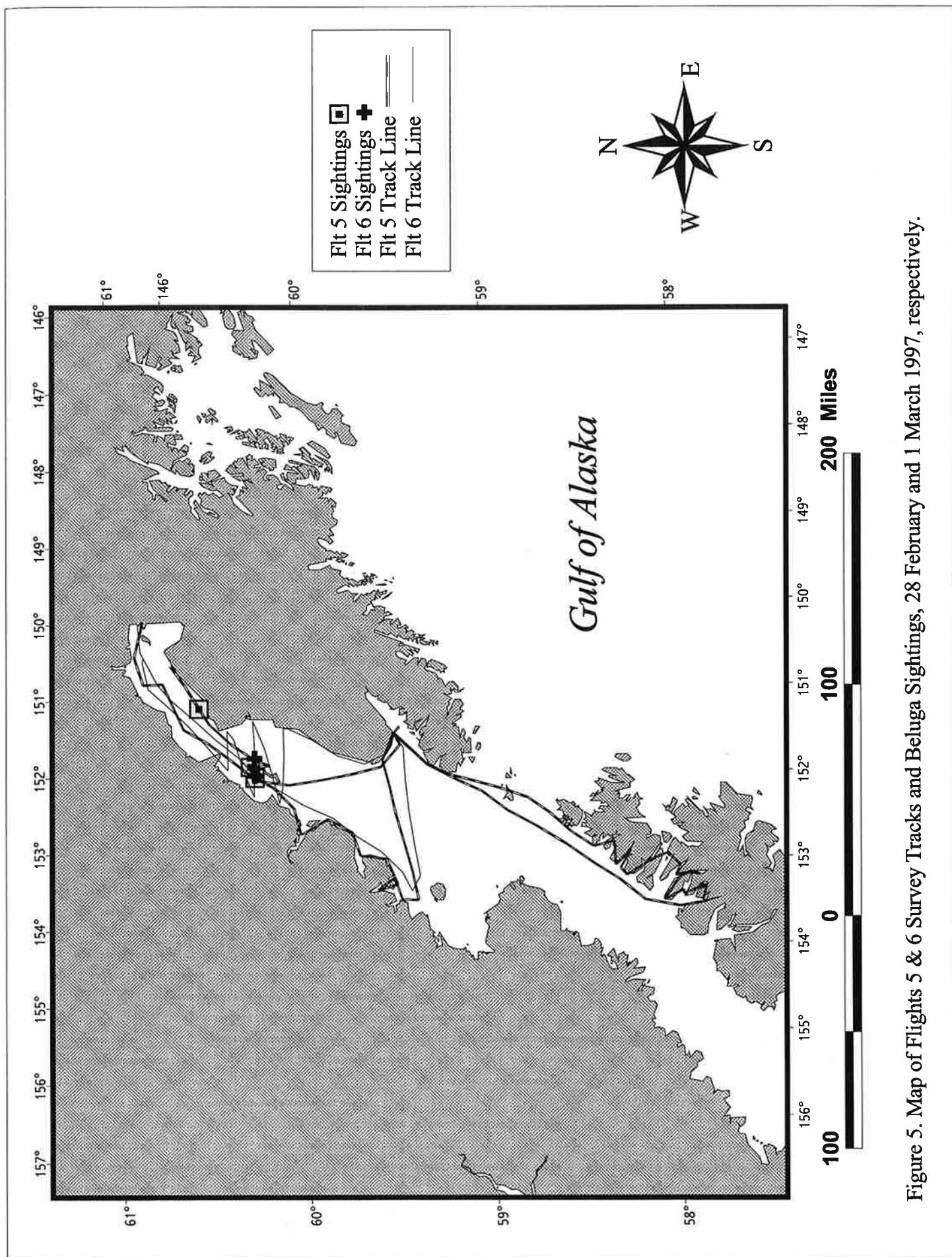


Figure 5. Map of Flights 5 & 6 Survey Tracks and Beluga Sightings, 28 February and 1 March 1997, respectively.

Table 6. Summary of Cetacean Sightings by Survey Flight and Date.

Day	Flight #	Beluga Whale	Harbor Porpoise	Killer Whale	Fin Whale	Dall's Porpoise	Unidentified Cetacean
12 Feb	1	12	0	0	0	0	0
15 Feb	2	0	0	0	0	0	0
19 Feb	3	10	8	0	0	0	0
20 Feb	4	0	3	0	0	0	0
28 Feb	5	50	0	0	0	0	0
01 Mar	6	34	0	0	0	0	0
03 Mar	7	0	0	0	3	0	0
12 Mar	8	24	6	0	0	0	0
13 Mar	9	11	2	0	0	0	5
14 Mar	10	19	16	3	0	11	0
Total		160	35	3	3	11	5

Table 7. Summary of Pinniped and Sea Otter Sightings by Survey Flight and Date.

Day	Flight #	Harbor Seal	Steller's Sea-Lion	Unidentified Pinniped	Sea Otter
12 Feb	1	0	0	0	1
15 Feb	2	0	0	0	0
19 Feb	3	13	0	3	66
20 Feb	4	0	5	0	8
28 Feb	5	20	422	11	40
01 Mar	6	0	0	31	0
03 Mar	7	18	50	1	307
12 Mar	8	22	0	16	209
13 Mar	9	13	0	0	142
14 Mar	10	354	117	0	11
Total		440	594	62	784

B. Beluga Whale Observations:

We observed a total of 160 belugas during the 10 aerial surveys (Table 3). This results in a sighting rate for individual flights ranging from 0 to 9.66 belugas/hour. Belugas in Cook Inlet were distributed in the middle portion of the inlet from the west side of Kalgin Island to just north of the East Foreland (Figure 4). Also, 10 belugas were observed near the Hubbard Glacier in Yakutat Bay. These represent the first documented occurrence of beluga whales in Yakutat Bay during winter (Hubbard, Hansen, and Mahoney, in press).

Maximum numbers of belugas and belugas/hour were observed in Cook Inlet on flights 5 and 6 on 28 February and 1 March, when surveys were conducted near Kalgin Island (Figure 5).

The location and behavior of each group of belugas sighted are given in Table 4. The most common behaviors observed were swimming (65% of individuals) and milling (27%); diving and resting behaviors were recorded much less often (Table 5). No beluga calves were recorded during any of the surveys. The gray-colored calves are difficult to see in the gray glacial-silt-laden waters of northern Cook Inlet and in the turbid waters near the Hubbard Glacier of Yakutat Bay. Alternatively, females with calves may not typically occur at this time of year in the areas where we observed whales.

In Cook Inlet, 73% of the whales for which headings were obtained were moving in a north to northeasterly (360 to 030 degrees) direction (Table 4). The remainder were heading northwest or southeast. A small group observed in Yakutat Bay (Flight #3) was heading east.

C. Beluga Distribution Relative to Ice Cover in Cook Inlet:

Beluga whales were observed in the Kalgin Island area in mid February when ice coverage was four- to six-tenths, and again in the same area from late February to mid March when there was no ice cover (Appendix C). The presence of extensive shorefast ice at the mouth of the Susitna River and other major streams made it difficult to see if whales were in these areas. Ice cover in the inlet reached its maximum advance south of Kalgin Island during late January (Appendix C, map for 31 January 1997), prior to these surveys. At its maximum, usually in January or February, sea ice can reach south to about Anchor Point on the east side of Cook Inlet and to southern Kamishak Bay on the west side (Brower et al., 1977). The winter of 1996–97 apparently was a light ice year for the inlet.

D. Other Marine Mammal Observations:

Other species observed during the surveys were harbor porpoise (*Phocoena phocoena*), Dall's porpoise (*Phocoenoides dalli*), killer whale (*Orcinus orca*), fin whale (*Balaenoptera physalus*), harbor seal (*Phoca vitulina*), Steller's sea-lion (*Eumetopias jubatus*), and sea otter (*Enhydra lutris*) (Tables 6–7, Figures 6–14, p. 17–25). Distribution of these sightings are as follows:

1. Harbor Porpoise: Harbor porpoises were the most widely distributed cetacean species sighted during the surveys (Figure 6). We observed porpoises in small pods scattered

from mid Cook Inlet south through Shelikof Strait, in Yakutat Bay, and along the Gulf of Alaska coast west of Icy Bay.

2. Fin Whale, Killer Whale, and Dall's Porpoise: A group of 3 fin whales was observed in the Shuyak Island area (Figure 7), and one group of 3 killer whales and 11 Dall's porpoises were observed in the Shelikof Strait area (Figures 8 and 9).

3. Harbor Seal: Most harbor seals observed were in Uyak Bay on the west side of Kodiak Island and in northern Kamishak Bay. Scattered sightings were made in Kachemak, Tuxedni, and Yakutat Bays (Figure 10). These sightings generally reflect the summer haul-out distribution of harbor seals along the Gulf of Alaska coast, although Prince William Sound, which we overflew once in transit to Yakutat Bay, has a substantial population. The concentration of sightings in Uyak Bay, where no major haul-outs have been identified (Hoover, 1988), may represent an unrecorded wintering area for harbor seals, a recent shift in their winter distribution, or an occasional winter use of this area.

4. Steller's Sea-Lion: Steller's sea-lion (Rice, 1998) sightings were scattered from the south side of the Alaska Peninsula to the Kodiak Island archipelago, the Barren Islands, and the Kayak Island area in the northeastern Gulf of Alaska (Figure 11). Some of these sightings are located near or on summer rookery locations, as in the Barren Islands (Hoover, 1988), while others may represent winter haul-out areas.

5. Sea Otter: The majority of otter sightings were in Kamishak and Kachemak Bays of lower Cook Inlet (Figure 12). Other sightings were scattered in northern Kodiak Island, Afognak Island, and Yakutat Bay. A few sightings were made in eastern Prince William Sound and the west side of Shelikof Strait. This distribution generally reflects the known distribution and abundance pattern of otters in the northern Gulf of Alaska (Calkins, 1987), but also represents survey effort in these areas. Sea otters were observed in Prince William Sound only near Cordova during the single flight between Anchorage and Yakutat.

6. Unidentified Cetaceans and Pinnipeds: Two sightings of 5 unidentified cetaceans, probably harbor porpoises, were made in Cook Inlet near Anchor Point (Figure 13). The distribution of unknown pinniped sightings (Figure 14) is very similar to that of harbor seals, so we assume that these animals probably are harbor seals.

V. DISCUSSION

During aerial surveys of the Cook Inlet-Kodiak Island-Shelikof Strait area in late winter (12 Feb to 14 March), groups of 12 to at least 50 beluga whales occurred consistently in the Kalgin Island area to just north of the East Foreland. It is probable that many of the 150 sightings of individuals in the Kalgin Island area were resightings of some of the same whales on successive surveys (Figure 5). National Oceanic and Atmospheric Administration images of sea-surface temperatures in Cook Inlet indicate a temperature gradient in the Kalgin Island area south of the forelands. The temperature gradient may be related to changes in ocean and tidal currents associated with coastal topography. The narrowing of the inlet in this area and the presence of

Kalgin Island just south of the forelands may cause upwelling and eddies that concentrate nutrients or act as a "still-water shelter area" for migrating anadromous fishes such as salmon, eulachon, and smelt, which are known beluga prey species (Calkins, 1983; 1989). The Kalgin Island area may be rich in biological productivity; crustaceans are known to occur south of the island (Calkins, 1983). The Kalgin Island area may serve as a late-winter staging area for eulachon prior to migration to their natal streams in upper Cook Inlet. If these fish and crustaceans generally are present in this area during late winter, they may be an important food source for any belugas overwintering in the inlet.

It generally is believed that Bering Sea populations of beluga whales disperse offshore during winter (Hazard, 1988). Likewise, the Cook Inlet stock also may disperse throughout the northern Gulf of Alaska, including lower Cook Inlet, Shelikof Strait, Kodiak Island, and northeastern gulf localities such as Yakutat Bay, where we observed a small number. Local residents and fishermen have observed belugas during the winter in bays along the coast of Kodiak and along the southern coast of the Alaska Peninsula (Appendix A: K. Wynne, National Marine Fisheries Service, Kodiak, and B. Priewe, Priewe Air). The Kalgin Island beluga whales may remain in Cook Inlet throughout the winter, or these whales may be a vanguard of animals arriving early in the inlet following the early migration of anadromous fishes. The Kalgin Island area may serve as a later winter staging area for eulachon and other prey of belugas.

Bob Priewe of Priewe Air has observed belugas in northern Cook Inlet throughout the winter in ice leads and open water on charter flights between Anchorage and Trading Bay on the west side of the inlet (Appendix A). Robert Gill, with the Biological Resource Division of the U.S. Geological Survey, has observed beluga whales in upper Cook Inlet during shorebird surveys conducted on the west side of the inlet. Most of his sightings occurred in the northwestern corner of the inlet, from the west channel of the Susitna River westward to the Ivan and Lewis Rivers (Gill, pers. comm., 1999). Gill (1999) sighted a large group of 75 belugas to the south in Tuxedni Bay in late October 1998, and observed groups of 5 and 2 individuals in Trading Bay 2 April 1999. Alan Bennett, formerly with the Lake Clark National Park and Preserve staff, observed substantial numbers of beluga whales in Tuxedni and Chinitna Bays in early to mid-April 1994–1996 (Bennett, 1996). These observations, together with those made during this study, suggest that at least some portion of the Cook Inlet population remains in the northern half of the inlet for at least part of some winters. However, no winter sightings of beluga were mentioned in an interview with village of Tyonek beluga hunter P. Merryman or in contacts with rig foremen on Unocal oil production platforms in northern Cook Inlet (Appendix A). The lack of sightings by hunters in Tyonek and oil industry personnel may simply indicate that belugas are more easily seen from the air than from onshore or from stationary platforms which provide a limited view of Cook Inlet. Also, it is not likely these observers spend significant periods looking for belugas during winter months.

Ross Schaeffer of the Alaska Beluga Whaling Committee mentioned that Cook Inlet belugas leave the inlet in winter and go to the Yakutat area. He referenced Walter Porter, a subsistence hunter and fisherman living in Yakutat. Mr. Porter said that belugas commonly occur along the west side of Yakutat Bay from Point Manby north to the Hubbard Glacier. John Vale, a commercial fisherman in Yakutat, and Robert Johnson, Alaska Department of Fish and Game, frequently see belugas on the west side of the bay during August and September near the mouths

of rivers. They believe that the whales are feeding on coho salmon. Interviews with these persons and other residents of the Yakutat area revealed that there was no documented information on beluga whale occurrence in the Yakutat area during winter months (November–March). Our observations of 10 belugas on 19 February 1997 is the first documented record of winter occurrence in the bay.

VI. SUMMARY

Ten aerial surveys for beluga whales were conducted in Cook Inlet during February and March 1997, and included parts of lower Kenai Peninsula, Shelikof Strait, and Kodiak Island. Yakutat Bay also was surveyed. Most of the survey effort was devoted to search surveys within about 3 km of coastlines; however, sets of parallel transects were flown within Cook Inlet and Yakutat Bay.

A total of 160 individual beluga whales were recorded during 9,406 km of survey effort; 72 sightings were made in February and 88 in March. Ten whales were observed near the Hubbard Glacier in Yakutat Bay (60°01' N, 139°33' W). This is the first documented record of beluga whales in Yakutat Bay during winter. The remainder were observed in the middle portion of Cook Inlet from the west side of Kalgin Island to just north of the East Foreland. The overall sighting rate of belugas was 3.57 whales/hour or 0.017 whales/km.

The Cook Inlet beluga whale stock may disperse throughout the northern Gulf of Alaska, including lower Cook Inlet, Shelikof Strait, Kodiak Island, and northeastern gulf localities such as Yakutat Bay. Belugas have been observed during winter in Kodiak Island bays and along the southern coast of the Alaska Peninsula. The beluga whales we observed near Kalgin Island may have remained in Cook Inlet throughout the winter, or may have been individuals following the early migration of anadromous fishes into the inlet. Observations by charter pilots and research personnel working in upper Cook Inlet during the winter indicate that some portion of the population remains in Cook Inlet for at least part of some winter seasons.

Incidental sightings of other marine mammals included 784 sea otters, 594 Steller's sea-lions, 440 harbor seals, 62 unidentified pinnipeds, 35 harbor porpoises, 3 fin whales, 11 Dall's porpoises, 3 killer whales, and 5 unidentified cetaceans.

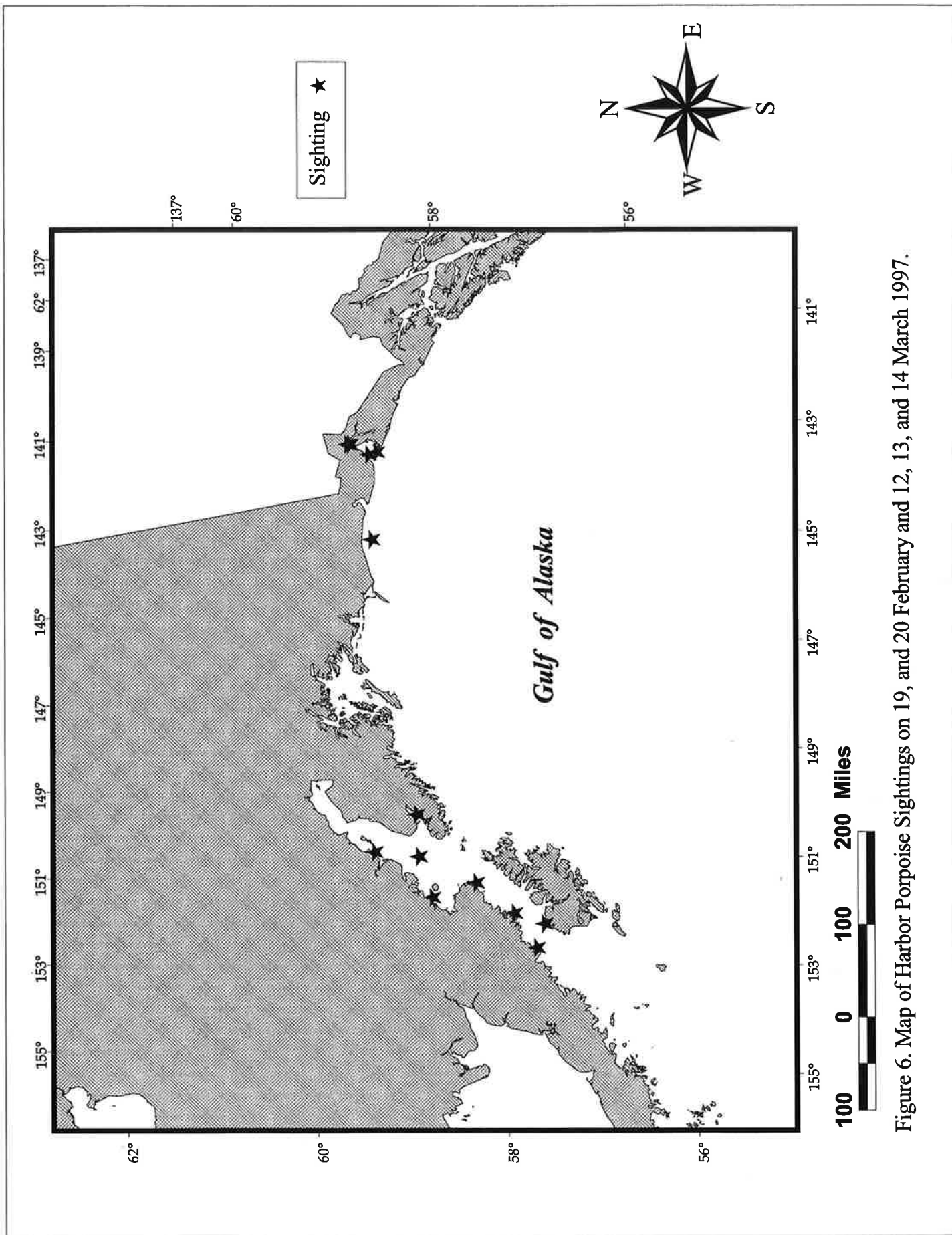


Figure 6. Map of Harbor Porpoise Sightings on 19, and 20 February and 12, 13, and 14 March 1997.

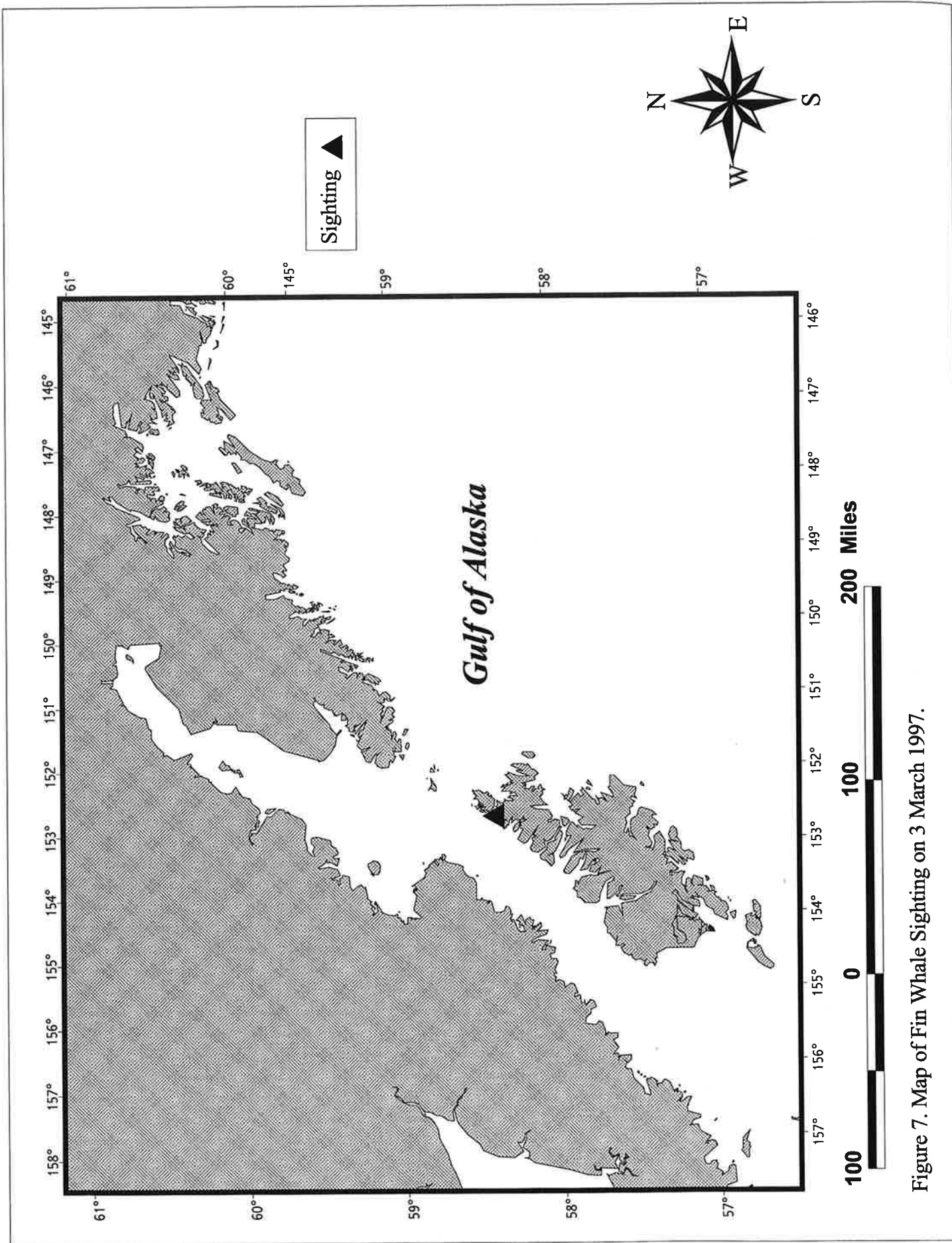


Figure 7. Map of Fin Whale Sighting on 3 March 1997.

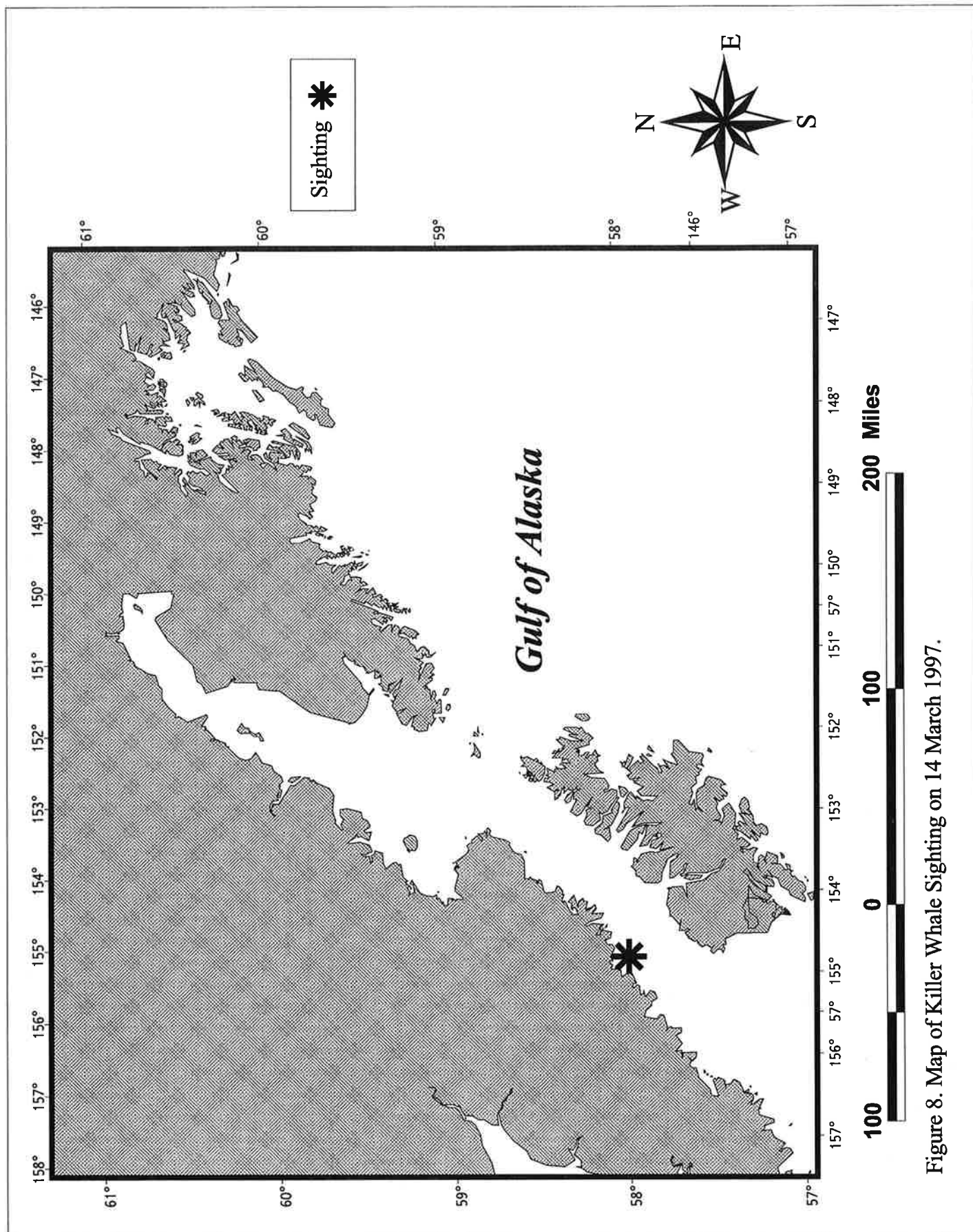


Figure 8. Map of Killer Whale Sighting on 14 March 1997.

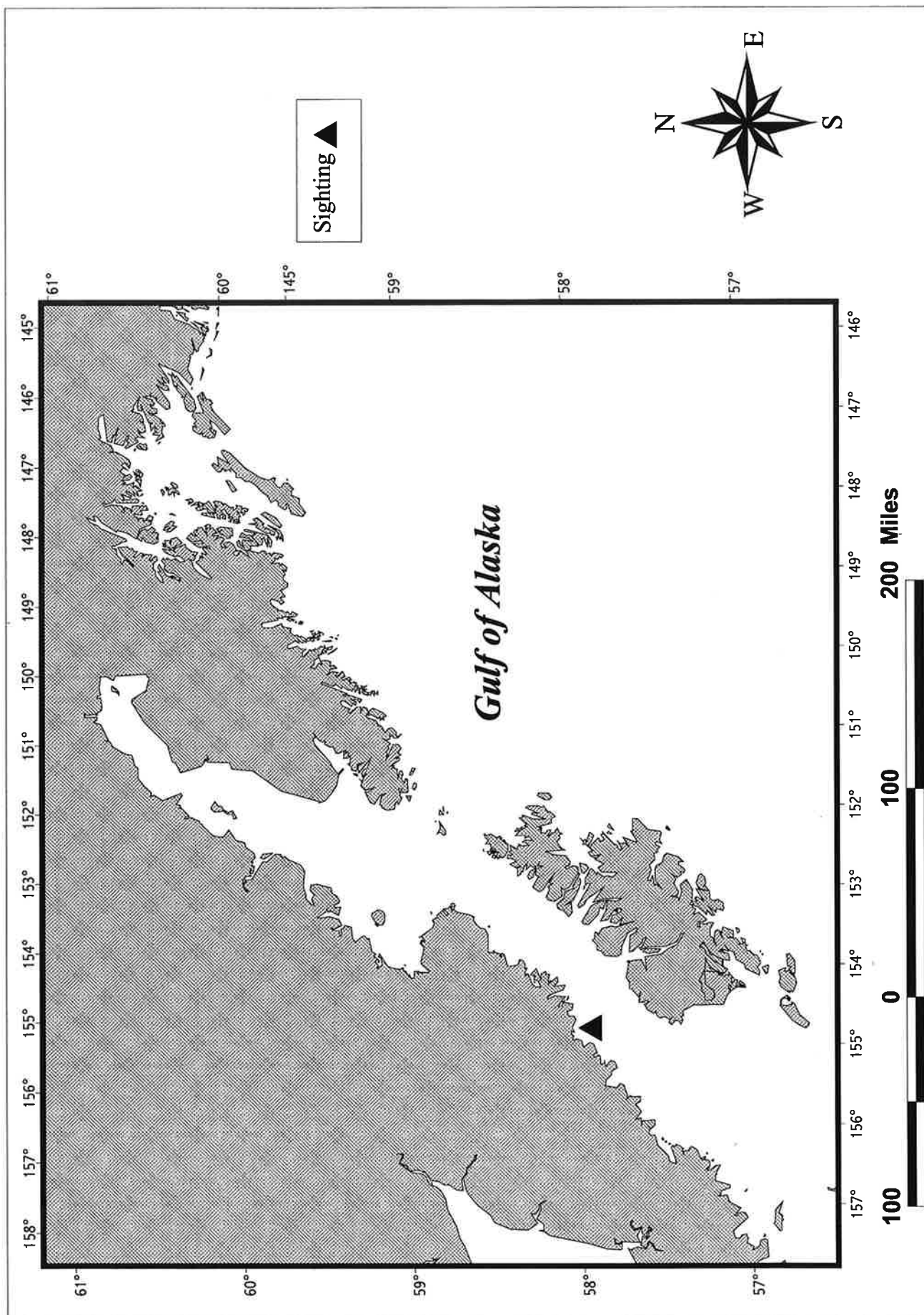


Figure 9. Map of Dall's Porpoise Sighting on 14 March 1997.

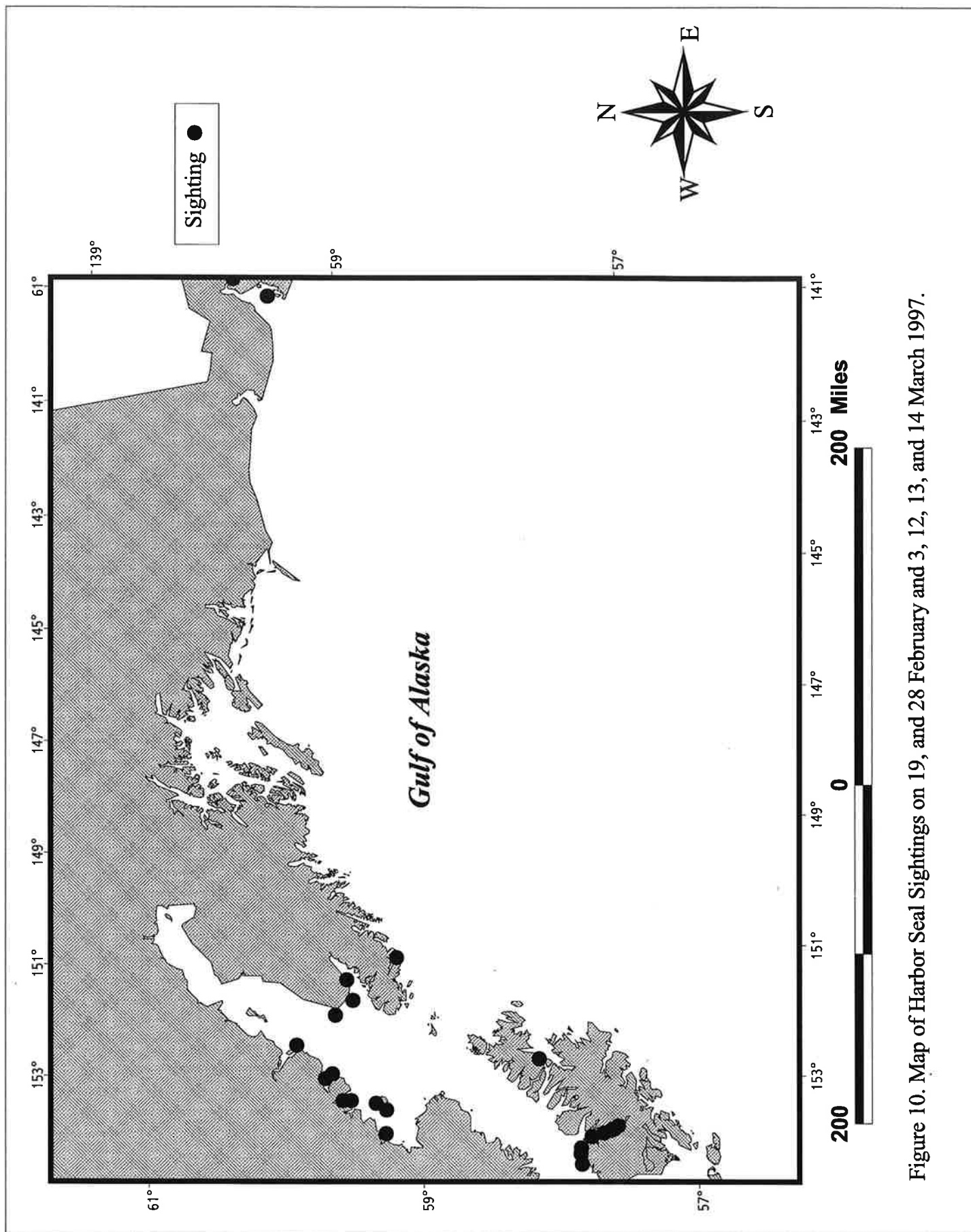


Figure 10. Map of Harbor Seal Sightings on 19, and 28 February and 3, 12, 13, and 14 March 1997.

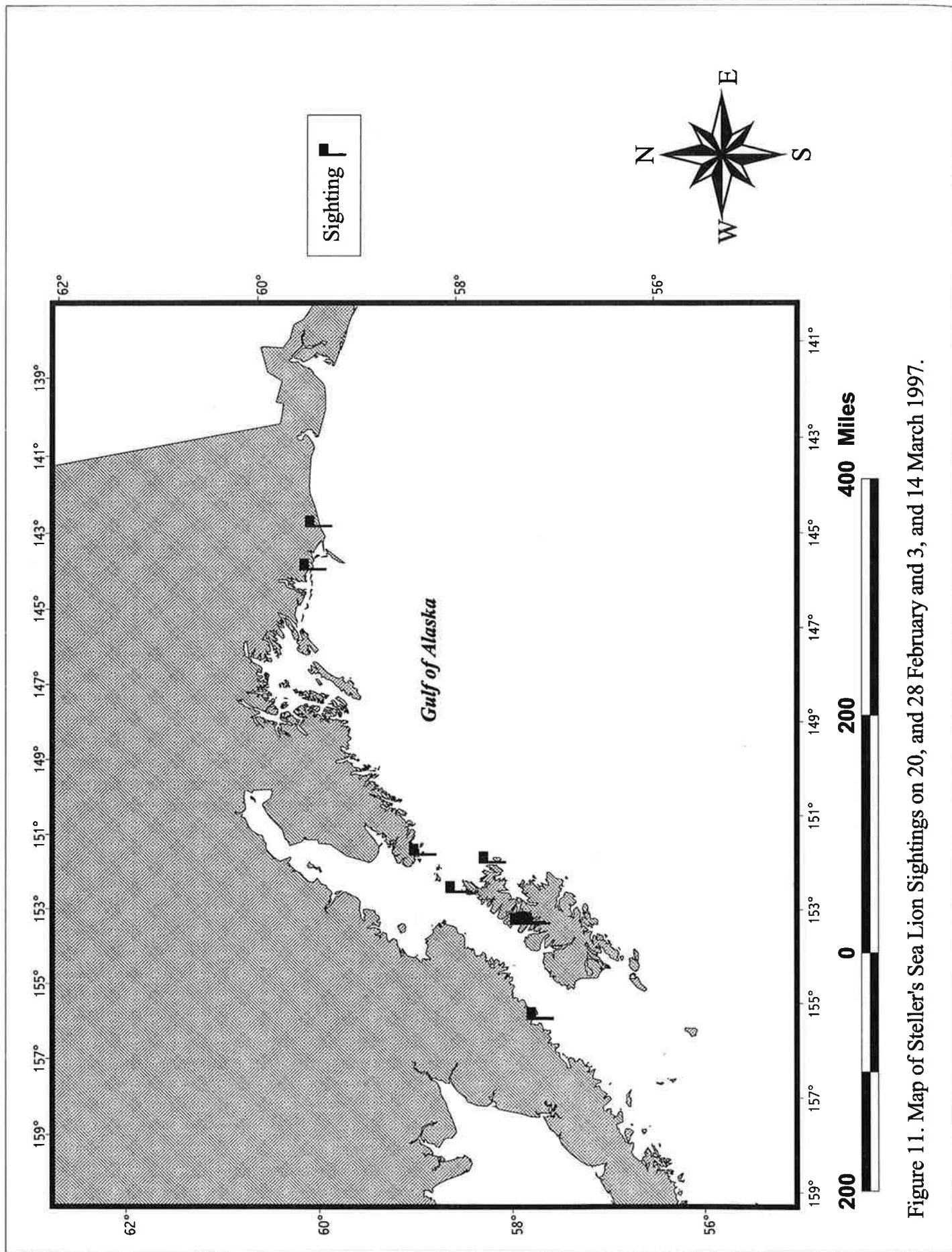


Figure 11. Map of Steller's Sea Lion Sightings on 20, and 28 February and 3, and 14 March 1997.

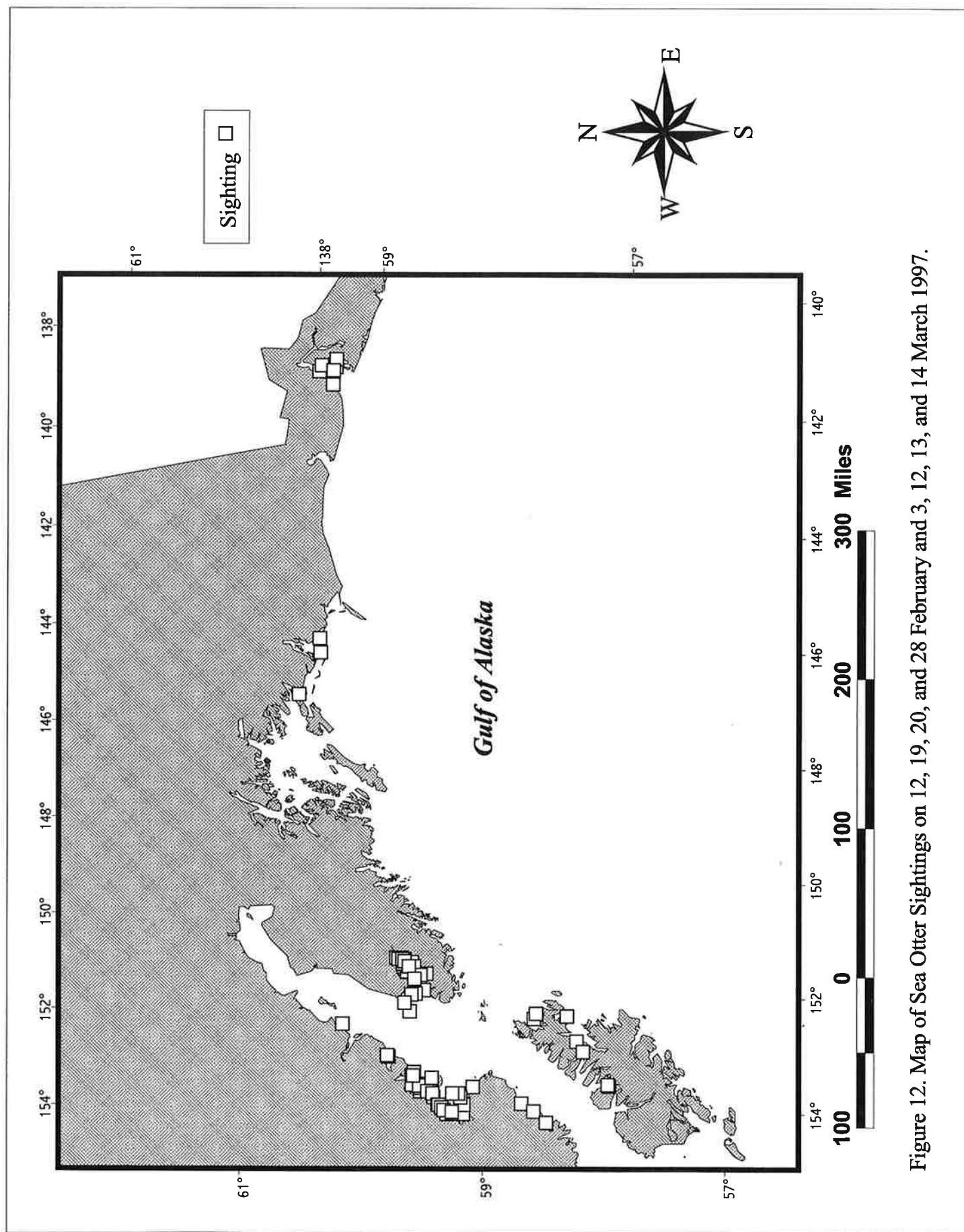


Figure 12. Map of Sea Otter Sightings on 12, 19, 20, and 28 February and 3, 12, 13, and 14 March 1997.

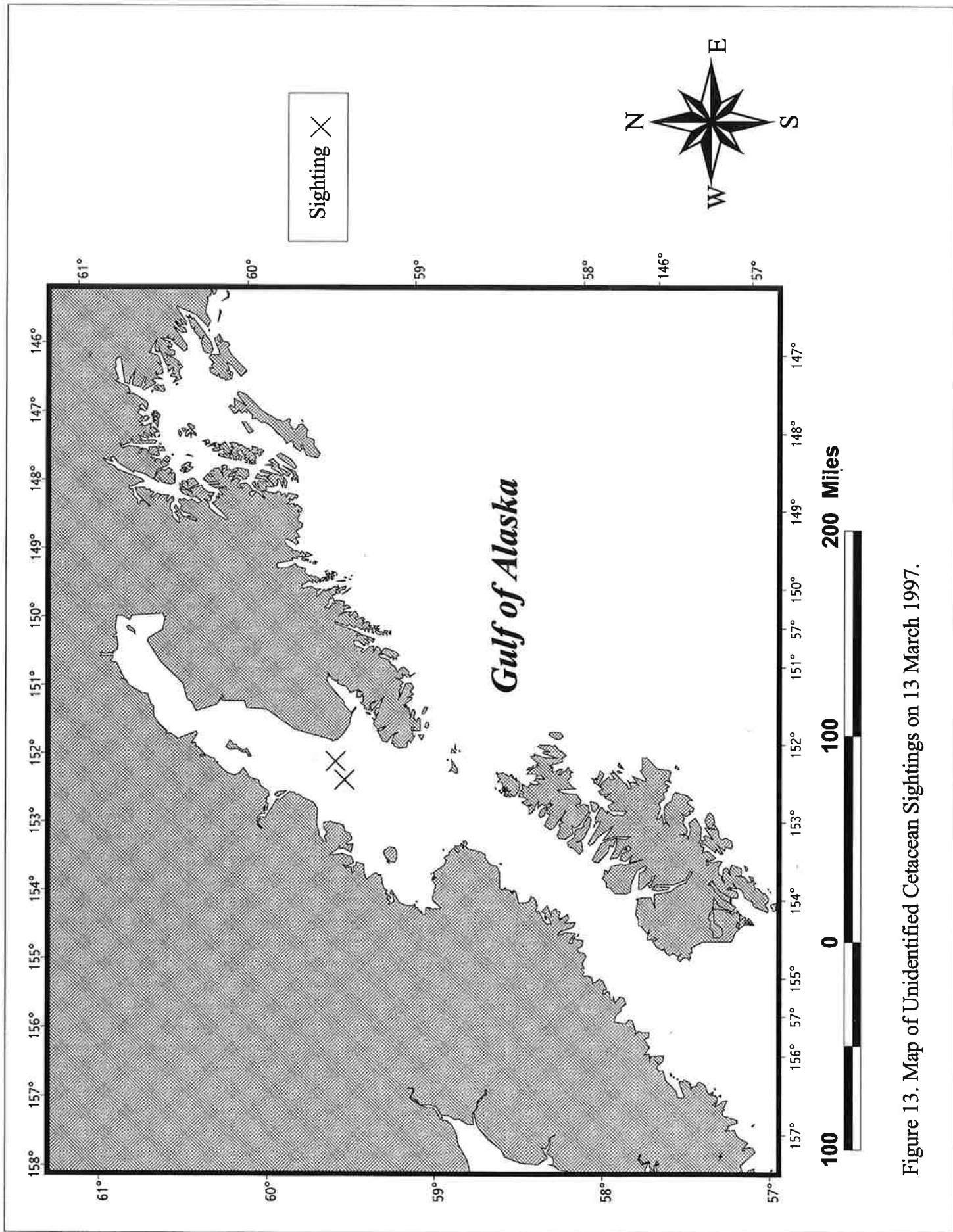


Figure 13. Map of Unidentified Cetacean Sightings on 13 March 1997.

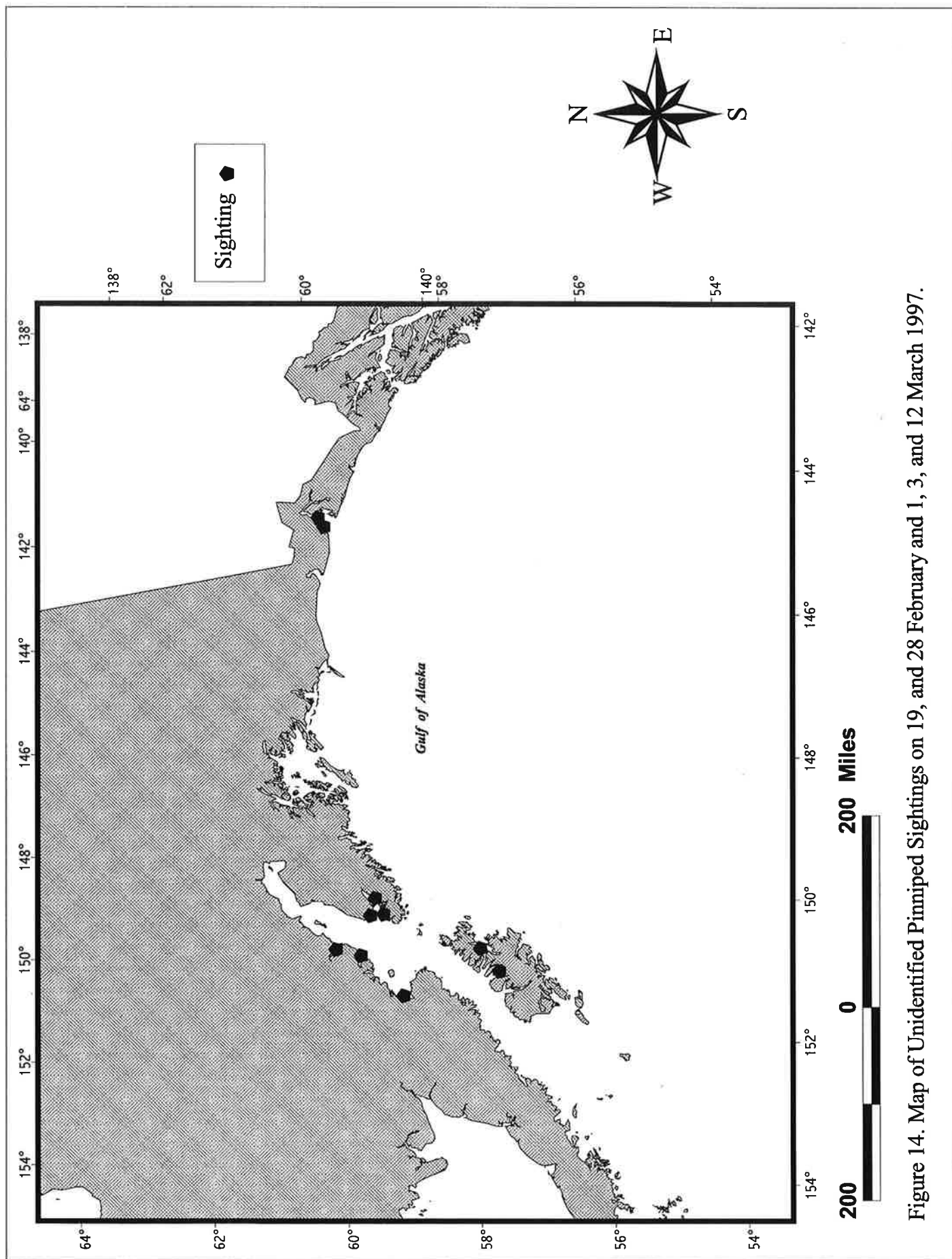


Figure 14. Map of Unidentified Pinniped Sightings on 19, and 28 February and 1, 3, and 12 March 1997.

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USDOC, NOAA, NMFS, National Marine Mammal Laboratory.

Appendix A

APPENDIX A

Coordination and Contacts with Native Groups, Individuals, Government Agencies, Non-Governmental Organizations, and Industry

1. Summary of Contacts

- The National Marine Fisheries Service was contacted, and they provided an experienced beluga whale observer for the Survey Team and information on subsistence hunting of beluga whales in Cook Inlet, including the names of subsistence hunters/whaling captains from Anchorage and Tyonek.
- Contacted the Alaska Beluga Whaling Committee and subsistence whalers from Anchorage and Tyonek to get information/traditional knowledge on where beluga whales go during the winter, the seasonal presence of belugas, and related information.
- Contacted Alaska Department of Fish and Game wildlife biologists for recent beluga whale winter sightings, etc., and to coordinate with this agency about the survey.
- Contacted U.S. Fish and Wildlife Service to coordinate with this agency about the survey.
- Contacted shipping industries such as Sea-Land, Inc., about shipping into the port of Anchorage during the winter and whether beluga whales are sighted in the shipping channel.
- Contacted oil companies operating in Cook Inlet–Trading Bay facilities about ice and weather conditions around production platforms, and information on any incidental sightings of beluga whales near the platforms or along vessel routes.

2. Complete List of Contacts

U.S. Government

Department of Commerce

National Marine Fisheries Service, Anchorage

Ron Morris

Brad Smith

Barbara Mahoney

National Marine Fisheries Service, National Marine Mammal Laboratory, Seattle, WA

Rod Hobbs

Sally Mizroch

National Marine Fisheries Service, Homer

Lee Selig

National Marine Fisheries Service, Kodiak

Kate Wynne

National Oceanic and Atmospheric Administration, National Weather Service, Anchorage

Department of Transportation, transcribed weather broadcast

Coast Guard

Marine Safety Office, Anchorage

Coast Guard Air Station, Sitka

Lt. Katie Howard

Lt. Dan Molthen

Department of Agriculture

Forest Service, District Ranger, Yakutat

Mr. Monty Fujishin

Copper River Delta Institute, Cordova

Mary Ann Bishop, Manager

Department of the Interior

Office of Aircraft Services

Brian Honer

U.S. Fish and Wildlife Service, Kodiak National Wildlife Refuge

Denny Zwiefelhofer

National Park Service

Jim Capra, Dry Bay

Chris Gabriele, Glacier Bay National Park

Dennis Kaleta, Yakutat

Alan Bennett, Lake Clark Park and Preserve

Bureau of Land Management

Mike Coffeen, Glenallen

State of Alaska, Department of Fish and Game

Anchorage

Don Calkins, Marine Mammal Biologist

Jim Fall, Subsistence Division

Ronald T. Stanek, Subsistence Division

Yakutat

Robert Johnson, Yakutat Sport Fish Division

Allen Burkholder, Commercial Fish Division

Douglas

Ben Carney, Division of Wildlife Conservation

Matt Robus, Division of Wildlife Conservation

Native Subsistence Groups and Individuals

Peter Merryman, President, Tyonek Alaska Village Council, Tyonek

Ross Schaeffer, Alaska Beluga Whale Committee, Kotzebue

Walter C. Porter, Yakutat

Yakutat Fish and Game Advisory Board

John Vale, Chairman

Industry Contacts

Sea-Land Freight Services, Inc.

UNOCAL Western Region Oil and Gas Exploration and Development, Anchorage

Alice Bullington, Environmental Coordinator

Ken Lucas, foreman, Grayling Platform, Cook Inlet

Allan Dorman, foreman, Baker Platform, Cook Inlet

Gary Ross, foreman, Anna Platform, Cook Inlet

Other Companies/Organizations

Kenai Fjords Tours, Anchorage and Seward

Renown Charters, Bill Stevens, Anchorage

Kenai Fjords Wildlife and Glacier Tour (Marine Tours), Anchorage

Pratt Museum, Homer

Prince William Sound Science Center, Cordova

Gulf Air Taxi, Curt Gloyer, Yakutat

Priewe Air, Bob Priewe, Anchorage

North Gulf Oceanic Society, Craig Matkin, Homer

Other Individuals

Larry Kritchen, Cordova

Ralph Lohse, Cordova

Appendix B

APPENDIX B
Flight Narratives and Maps of Flight Tracks

Flight No. 1: 12 February 1997

Flight No. 2: 15 February 1997

Flight No. 3: 19 February 1997

Flight No. 4: 20 February 1997

Flight No. 5: 28 February 1997

Flight No. 6: 1 March 1997

Flight No. 7: 3 March 1997

Flight No. 8: 12 March 1997

Flight No. 9: 13 March 1997

Flight No. 10: 14 March 1997

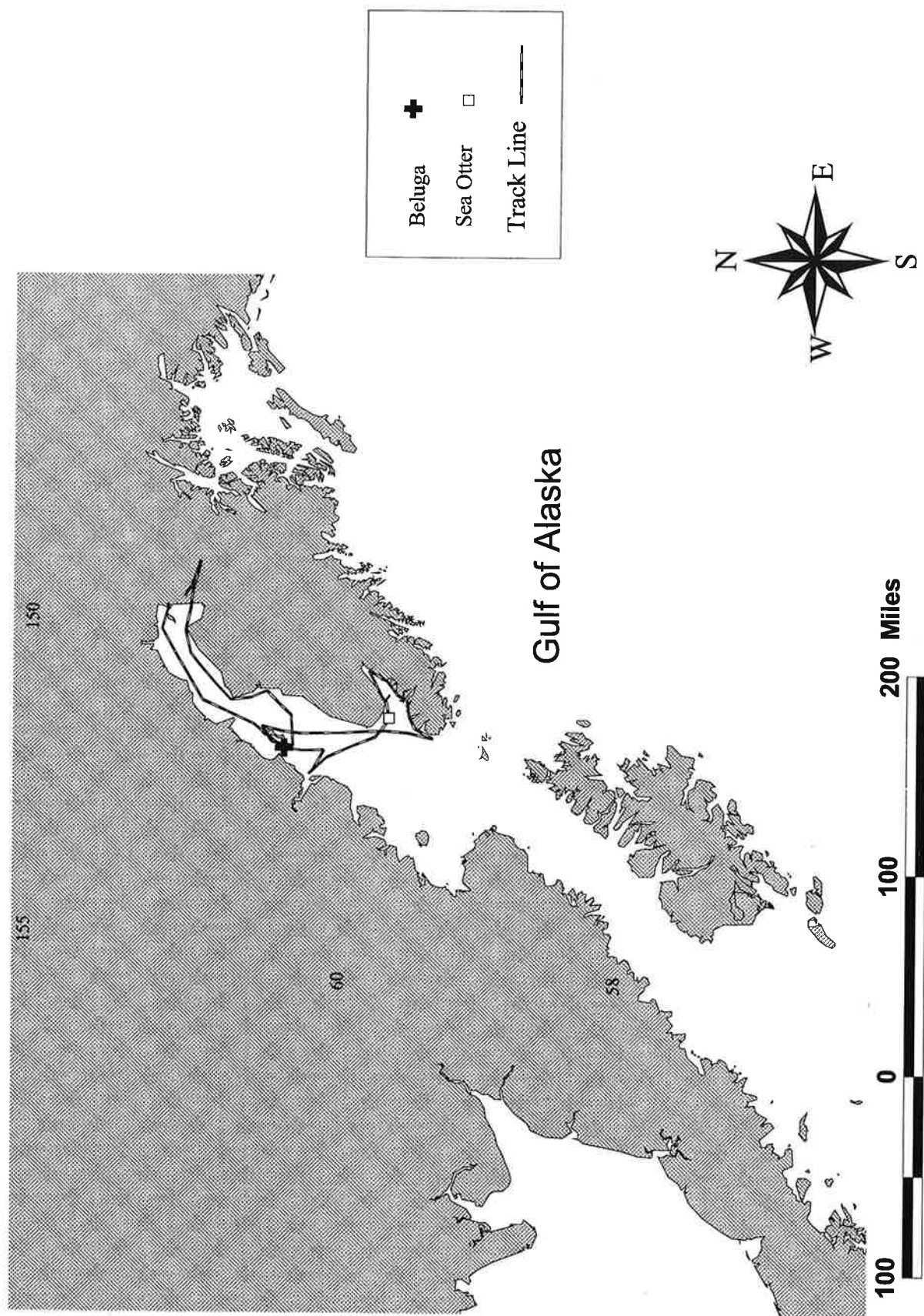


Figure B-1. Map of Flight 1 Survey Track and Marine Mammal Sightings on 12 February 1997.

Flight No. 1: 12 February 1997. Weather was VFR on the east side of Cook Inlet from Kachemak Bay north to Anchorage and Turnagain Arm, VFR on the west side of the inlet from north of Tuxedni Bay to Knik Arm, and MVFR south of these locations. New (young) brash ice was present in upper and mid Cook Inlet south to around Kalgin Island (Appendix C, 12 Feb. 1997). Flight #1 headed south down the west side of upper Cook Inlet and passed along the west side of Kalgin Island. 12 beluga whales were spotted near the southwest end of the island (Figure B-1). The survey then flew south toward Tuxedni Bay. Previous studies had recorded winter sightings of belugas near the southwest corner of Kalgin Island and in Tuxedni Bay. MVFR to IFR conditions were present in Tuxedni Bay, so the flight diverted from Chisik Island at the mouth of the bay and headed southeast across Cook Inlet to Homer and Kachemak Bay. Flight #1 followed the north coast of Kachemak Bay to the head of the bay, continued along the south side of the bay to near Seldovia, then turned north to Kalgin Island, circled the island on the east and again on the west (no belugas were resighted), crossed the inlet heading toward the mouth of the Kenai River, then surveyed Turnagain Arm and flew back to Anchorage. The flight covered 828 search km and counted a total of 12 beluga whales.

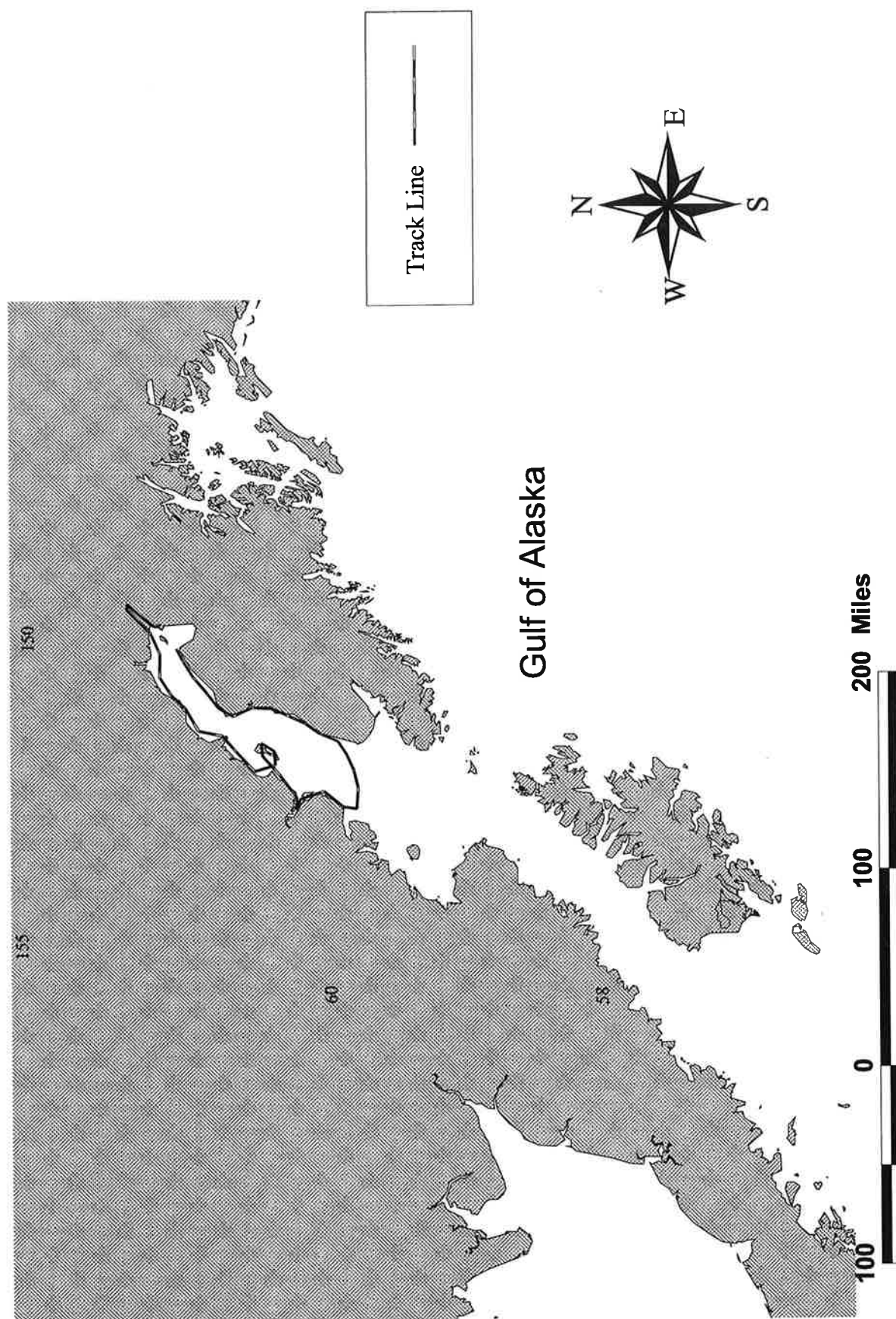


Figure B-2. Map of Flight 2 Survey Track 15 February 1997.

Flight No. 2: 15 February 1997. Weather was VFR in upper Cook Inlet and south to Tuxedni Bay on the west side of the inlet. Flight #2 surveyed upper Cook Inlet and Knik Arm, continued west to the mouth of Big Susitna River, followed the west coast of the inlet south past Tyonek, and circled Kalgin Island (Figure B-2). The flight continued south along the west coast of the inlet, surveyed Tuxedni Bay and the coast south to the mouth of Chinitna Bay, then headed east across Cook Inlet. Flight #2 headed north past Ninilchik along the east coast of the inlet, past the East Forelands, and back to Anchorage.

No beluga whales were seen.

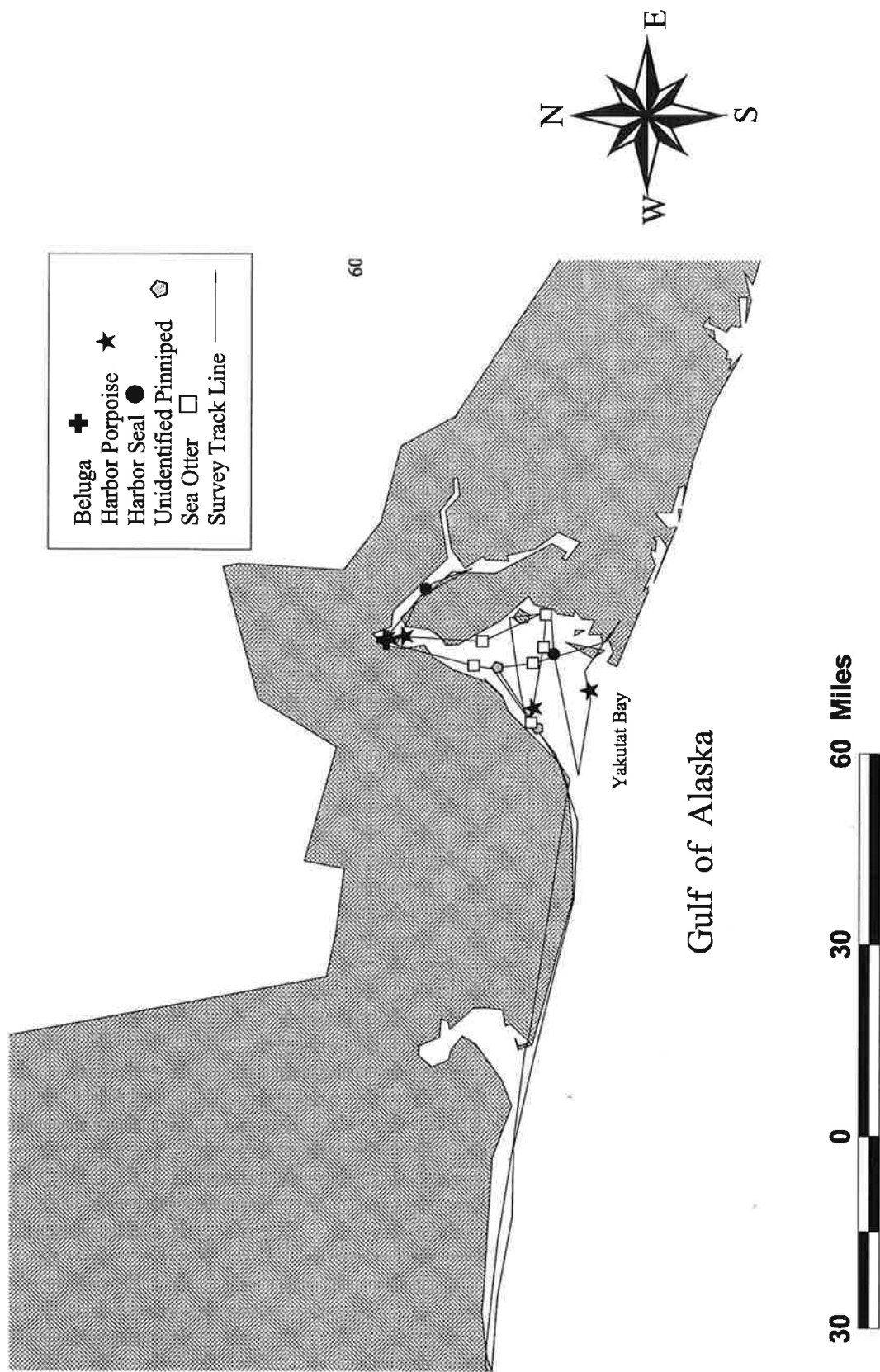


Figure B-3. Map of Flight 3 Survey Track and Marine Mammal Sightings on 19 February 1997.

Flight No. 3: 19 February 1997. Weather was VFR for most of Cook Inlet, Prince William Sound, and the Gulf of Alaska, including the Yakutat Bay area. We decided to fly to Yakutat because of information from Native whalers, commercial fishermen, and others from Cook Inlet and Yakutat who mentioned that beluga whales occur frequently in Yakutat Bay during late summer and fall (Appendix A, Native Subsistence Groups and Individuals: Peter Merryman, Tyonek; Russ Schaeffer, Kotzebue; and Walter C. Porter, Yakutat). Flight #3 headed south from Anchorage and east through Portage Pass and Prince William Sound to Cordova. We saw several sea otters near Cordova. Flew from Cordova over the Bering Ice Field and forelands to Yakutat Bay (Figure B-3). Flight #3 headed north into Yakutat Bay along the west coast of the bay through Disenchantment Bay to the foot of the Hubbard Glacier. Initially 3 belugas were spotted near the foot of the glacier in turbid water. The aircraft circled the location and one pod of 4 and another of 6 belugas were spotted, for a total of 10 belugas counted. Flight #3 continued up Russell Fiord, but no whales were spotted in the fiord. The aircraft returned to Hubbard Glacier and at least 5 beluga whales were resighted. Flight #3 continued south along the east coast of Disenchantment Bay--upper Yakutat Bay to Knight Island, where the first of 4 transects across Yakutat Bay were flown. The last transect ended in Monti Bay near the city of Yakutat. After refueling in Yakutat, Flight #3 tried to make it to Cordova, but low ceilings forced the aircraft back to Yakutat after reaching the Kayak Island area.

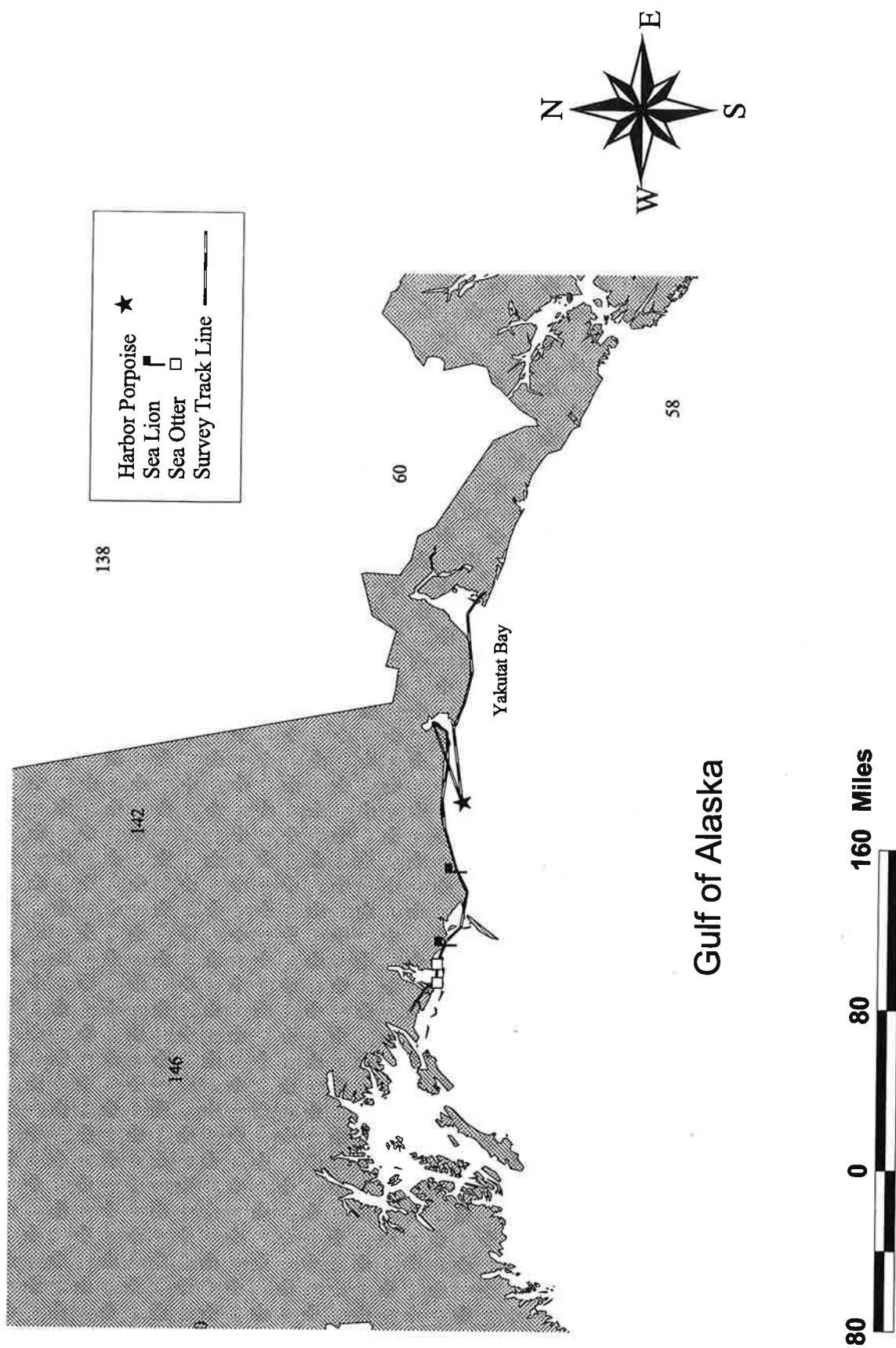


Figure B-4. Map of Flight 4 Survey Track and Marine Mammal Sightings on 20 February 1997.

Flight No. 4: 20 February 1997. Weather was MVFR to Cordova from Yakutat Bay. Flight #4 headed west from Yakutat airport across the mouth of Yakutat Bay, continued west along the coast of the Gulf of Alaska to Icy Bay, and flew one survey loop into Icy Bay. Flight #4 then continued west along the coast between Kayak Island and Controller Bay and on to Cordova (Figure B-4). No beluga whales were seen in Icy Bay, nor along the coast between Yakutat Bay and Cordova. Flight #4 flew IFR back to Anchorage from Cordova.

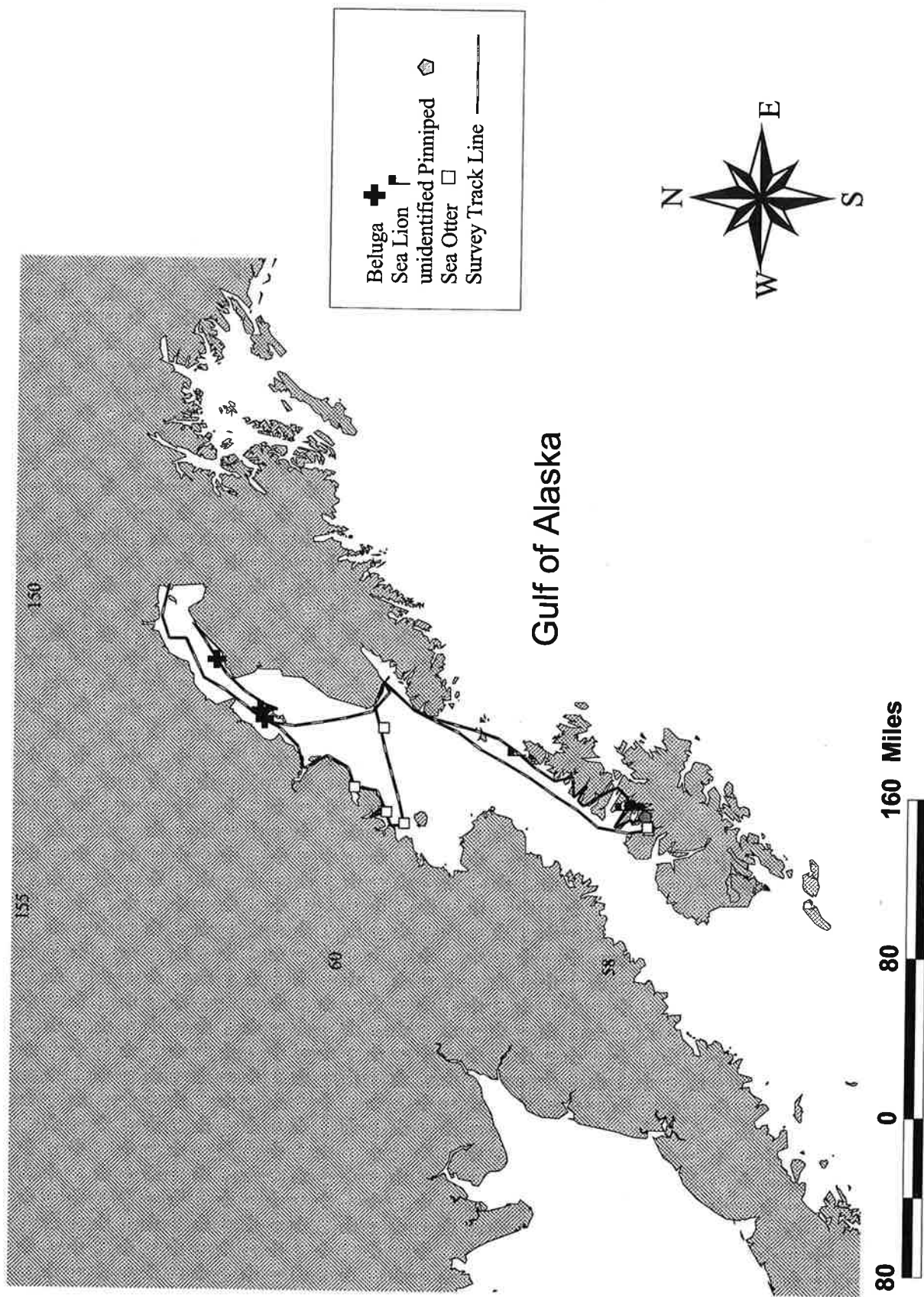


Figure B-5. Map of Flight 5 Survey Track and Marine Mammal Sightings on 28 February 1997.

Flight No. 5: 28 February 1997. Weather was VFR for Cook Inlet, Kodiak Island, and the western Gulf of Alaska; no turbulence was reported. In Cook Inlet, the only ice was young brash ice present in Knik Arm, the mouth of Big Susitna River, and in bays on the west side of Cook Inlet (Appendix C, 28 February 1997). Flight #5 headed south down Cook Inlet past the west side of Kalgin Island (no belugas were spotted) and on to Homer for refueling. Flight #5 then headed south to Shelikof Strait and Uganik Bay (where belugas were reported by Uganik residents, according to Kate Wynne, National Marine Fisheries Service, Kodiak). Flight #5 surveyed along the west coast of Kodiak, Raspberry, and Afognak Islands (Figure B-5). No belugas were seen along the coast nor in any of the bays on the west side of the islands. Flight #5 returned to Homer for refueling, crossed the inlet to northern Kamishak Bay-Iniskin Bay, and flew north along the west coast of Cook Inlet including Tuxedni Bay. Flight #5 then circled Kalgin Island. Belugas were spotted west and just north of the island (Figure B-5). Flight #5 then headed across the inlet towards the East Forelands. A group of 13 belugas were spotted offshore of Nikiski north of the East Forelands. Flight #5 then continued back to Anchorage. A total of 50 beluga whales were counted.

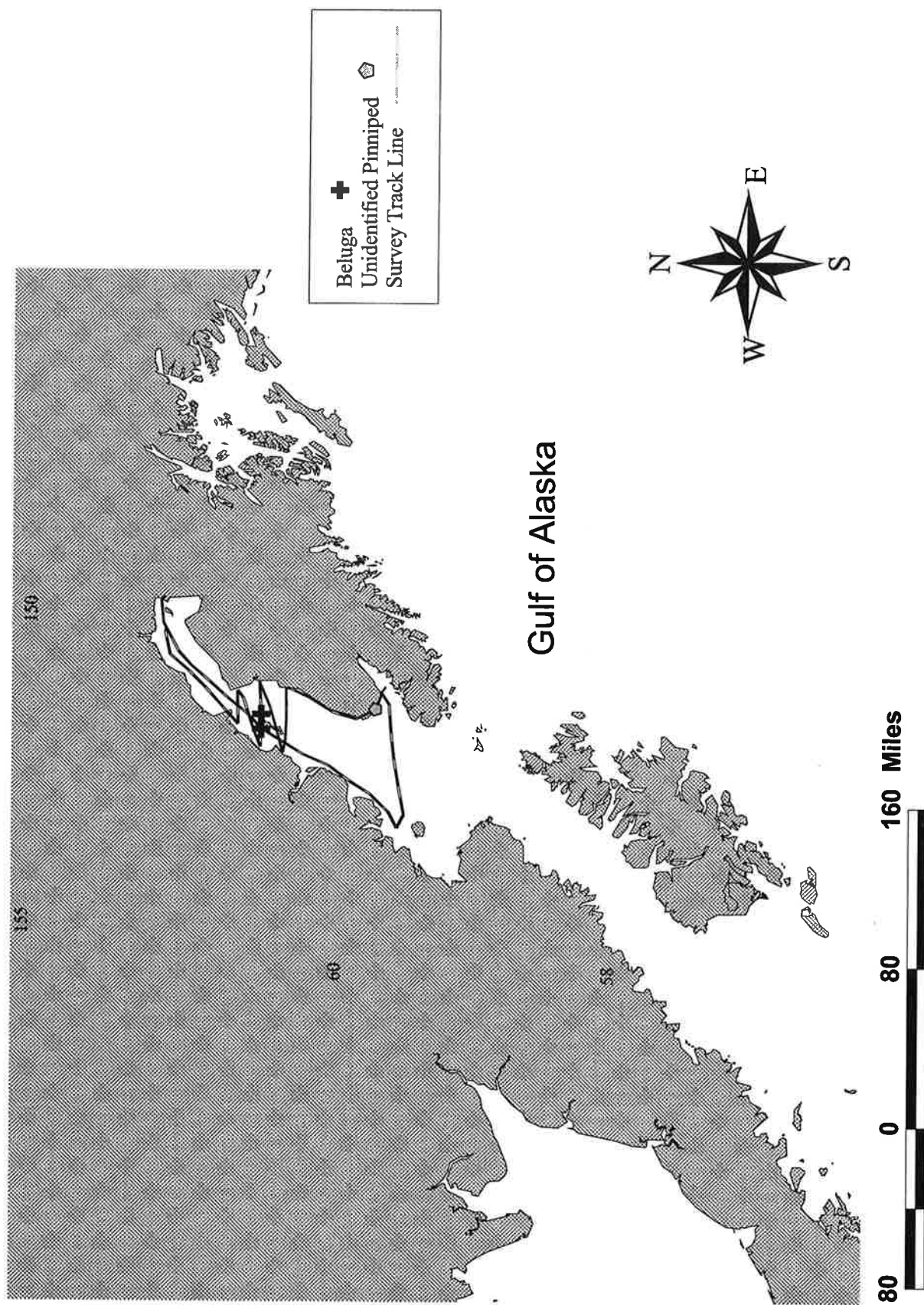


Figure B-6. Map of Flight 6 Survey Track and Marine Mammal Sightings on 1 March 1997.

Flight No. 6: 1 March 1997. Weather was VFR for Cook Inlet and all of Gulf of Alaska north of southeast Alaska. Flight #6 headed south from Anchorage down the center of Cook Inlet to the west side of Kalgin Island. Spotted 12 belugas on the west side of the island (Figure B-6). Flight #6 continued south along the west side of the inlet into Kamishak Bay. Very high winds and sea states were present there, so we headed for Homer to refuel. We checked on the weather in Homer. Winds were high in lower Cook Inlet, but winds were lower and the sea state was surveyable in mid to upper Cook Inlet. Flight #6 headed north along the east coast of the inlet. Just past Clam Gulch, we began a series of systematic transects across the inlet—first traveling west just south of Kalgin Island, then northeast across Kalgin Island, then west just north of Kalgin Island (22 belugas were spotted along this transect), then northeast to just south of the East Forelands, and finally west to just south of the West Forelands. From there, flight #6 headed northeast along the west coast of upper Cook Inlet to the mouth of the Big Susitna River and directly back to Anchorage. A total of 34 beluga whales were counted.

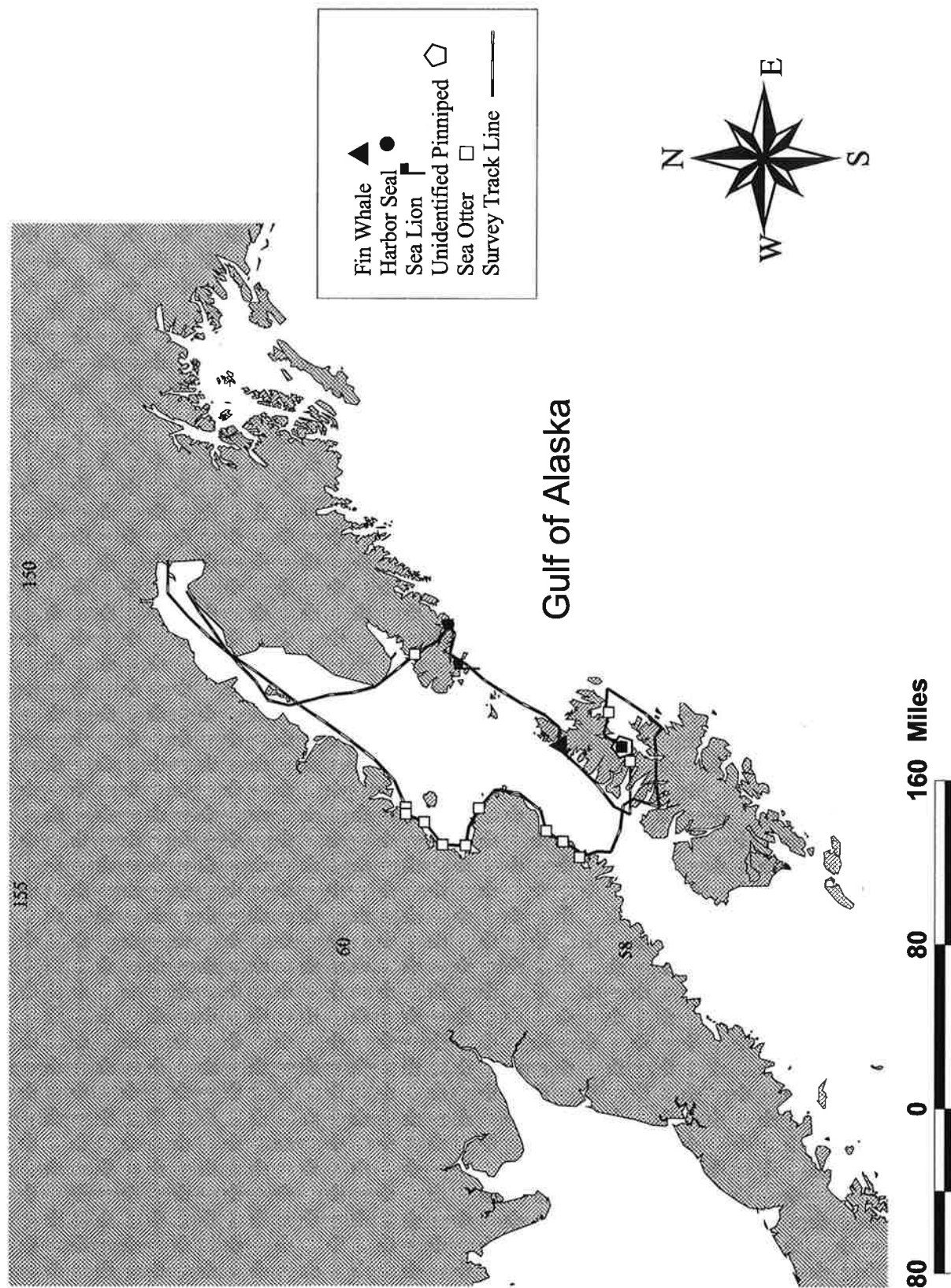


Figure B-7. Map of Flight 7 Survey Track and Marine Mammal Sightings on 3 March 1997.

Flight No. 7: 3 March 1997. Weather was VFR for Cook Inlet, Shelikof Strait, and the Kodiak areas. The ice report showed young brash ice floes along the shorelines of upper Cook Inlet and in bays on the west side of mid and lower Cook Inlet (Appendix C, 3 March 1997). Flight #7 headed south down about the middle of Cook Inlet and passed just east of Kalgin Island. The flight continued south to Kamishak Bay (Figure B-7), then followed the coast of the bay, including Ursus Cove and inner Kamishak Bay. The flight rounded Cape Douglas, followed the coast of the Alaska Peninsula to south of Kukak Bay, crossed Shelikof Strait, flew through Uganik Bay, and landed in the town of Kodiak for refueling. The flight then headed around Marmot Bay, through Kupreanof Strait, along the east side of Shelikof Strait (west side of Afognak Island), through Shuyak Strait, and past the east side of Shuyak Island. Three fin whales were sighted near Shuyak Island (Figure B-7). Flight #7 then headed north through the Barren Islands, continued past the Chugach Islands to the southern tip of the Kenai Peninsula, headed east to Gore Point, and crossed the peninsula to Kachemak Bay. Flight #7 then headed north up Cook Inlet past the west side of Kalgin Island and on to Anchorage. No beluga whales were seen on this flight.

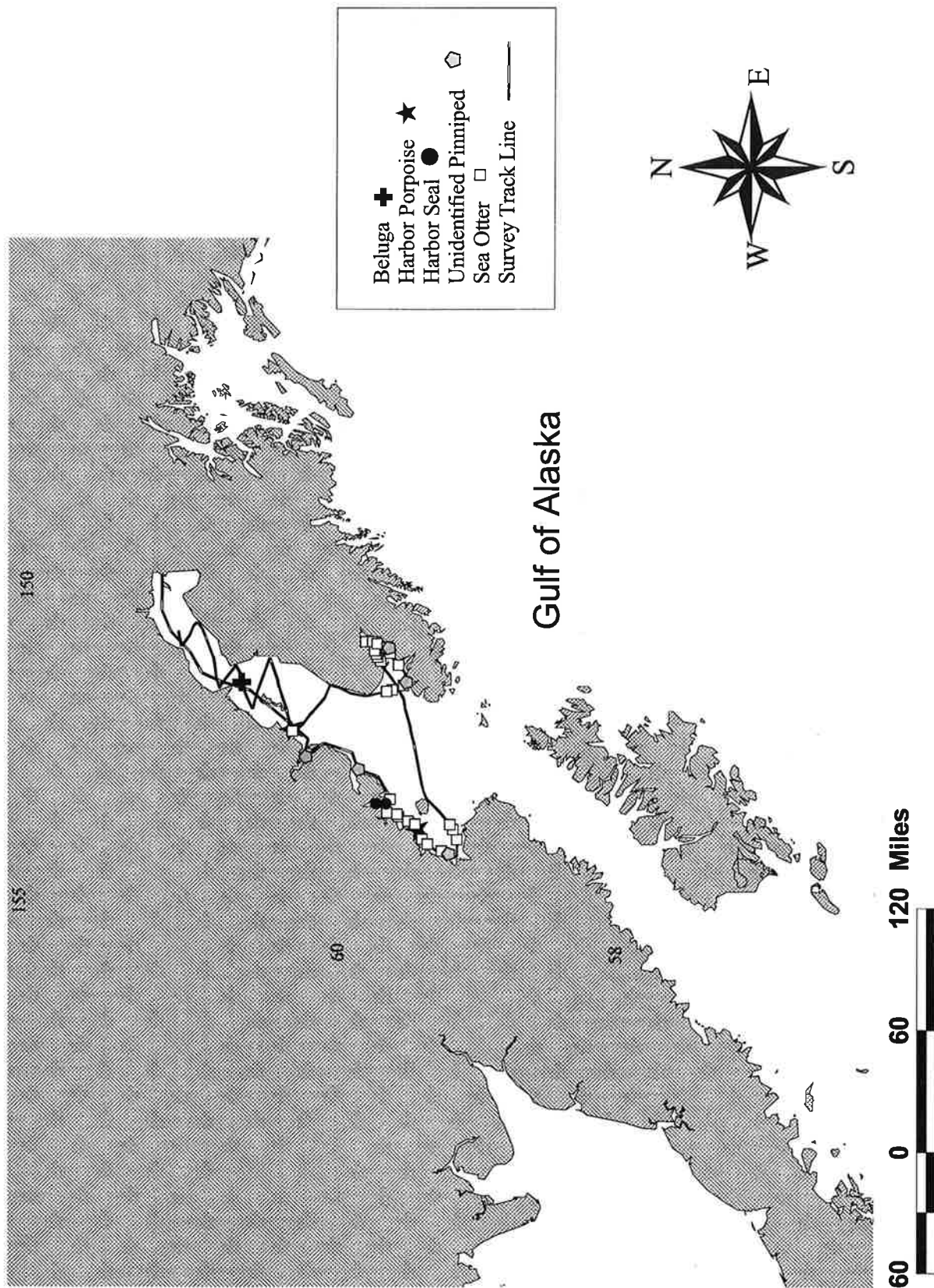


Figure B-8. Map of Flight 8 Survey Track and Marine Mammal Sightings on 12 March 1997.

Flight No. 8: 12 March 1997. Weather was VFR for all of Cook Inlet, Kodiak, Shelikof Strait, and the Gulf of Alaska. The ice report showed young floe ice in concentrations of 7-9, 8-10, and 9-10 tenths in upper Cook Inlet extending south of the East and West Forelands, in Tuxedni and Chinitna Bays, and along the south side of Kamishak Bay (Appendix C, 12 March 1997). Flight #8 headed south along the west side of Cook Inlet past Kalgin Island and into the mouth of Tuxedni Bay, then continued south into Chinitna Bay and along the coast of Kamishak Bay past Augustine Island. The flight then turned northeast, crossed Cook Inlet just south of Augustine Island, and landed in Homer for refueling (Figure B-8). Flight #8 surveyed inner Kachemak Bay along the shoreline to the head of the bay and then along the south shore to Seldovia. The flight then headed north across the mouth of Kachemak Bay toward Anchor Point and followed the coast to Cape Nimilchik. Here the flight began a series of northwest/northeast transects across Cook Inlet—traveling first northwest to Redoubt Point; then northeast past the southern end of Kalgin Island to Karluk Reef (south of the Kenai River); then northwest past the northern end of Kalgin Island toward the Drift River; northeast to a point near Nikiski south of the East Forelands (24 belugas were counted along this transect, Figure B-8); northwest to a point in Trading Bay (Micro Tower); northeast to Birch Hill; and finally northwest toward the village of Tyonek. The flight then headed back to Anchorage. A total of 24 beluga whales were seen.

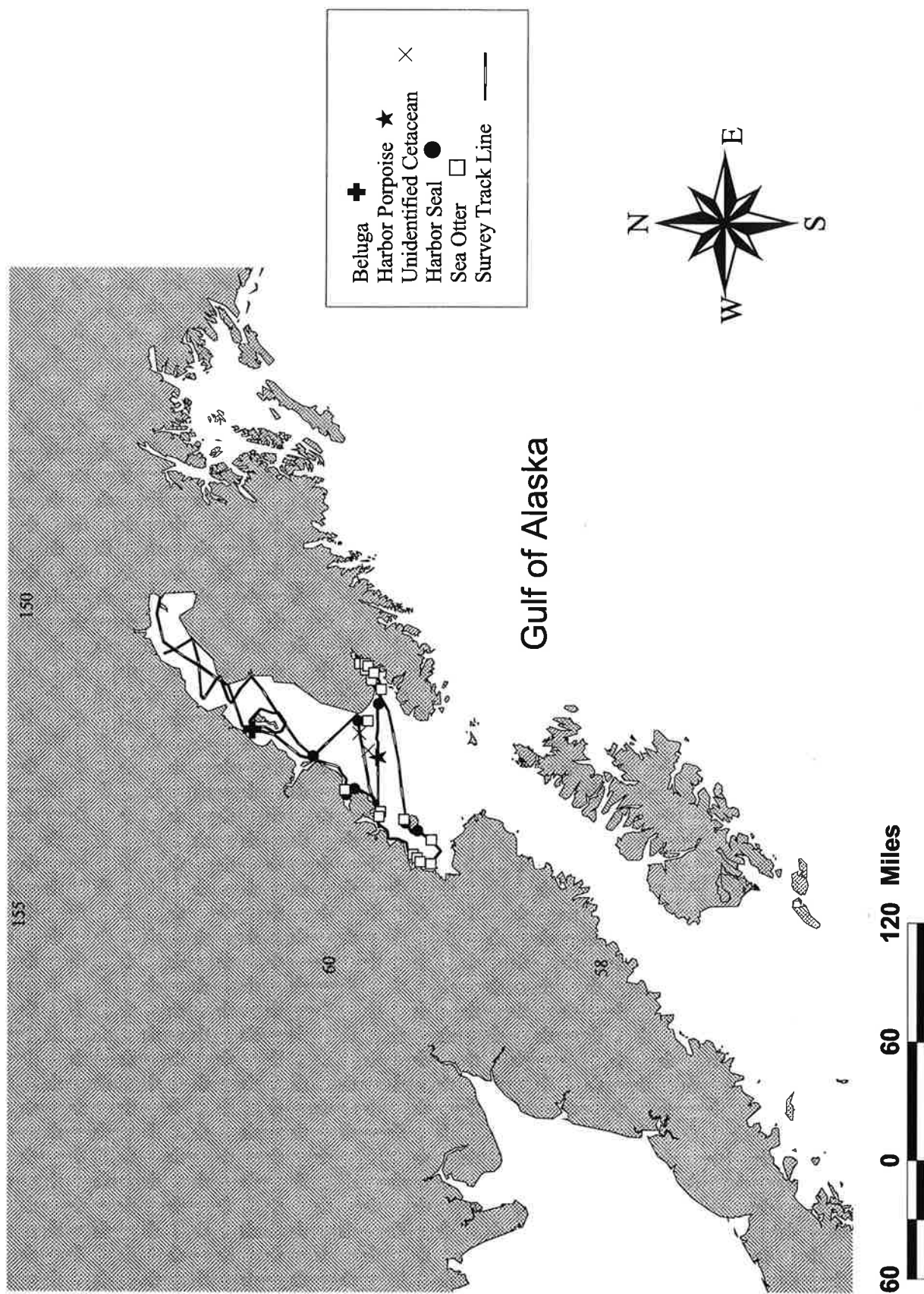


Figure B-9. Map of Flight 9 Survey Track and Marine Mammal Sightings on 13 March 1997.

Flight No. 9: 13 March 1997. Weather was VFR for all of Cook Inlet and the Gulf of Alaska. Flight #9 headed south down the middle of Cook Inlet toward the East Forelands and Nikiski, turned southwest toward Redoubt Point, then turned southeast and circled Kalgin Island (Figure B-9). 11 beluga whales were seen west of Kamishak Bay. Flight #9 flew south along the west coast of the inlet to Kamishak Bay, continued into inner Kamishak Bay, turned northeast past the north side of Augustine Island, and crossed the inlet to Homer. After refueling in Homer, flight #9 surveyed the coast of inner Kachemak Bay. The flight then began a series of transects across Cook Inlet. From Kachemak Bay, flight #9 went west across the inlet to Iliamna Bay; then east to Anchor Point; northwest toward Chisik Island; northeast toward the mouth of the Kenai River; northwest toward the West Forelands; northeast to Boulder Point north of the East Forelands; northwest toward a point on the coast of Trading Bay; northeast to Moose Point; and finally northwest toward the mouth of the Beluga River. Flight #9 then headed back to Anchorage. A total of 11 beluga whales were counted.

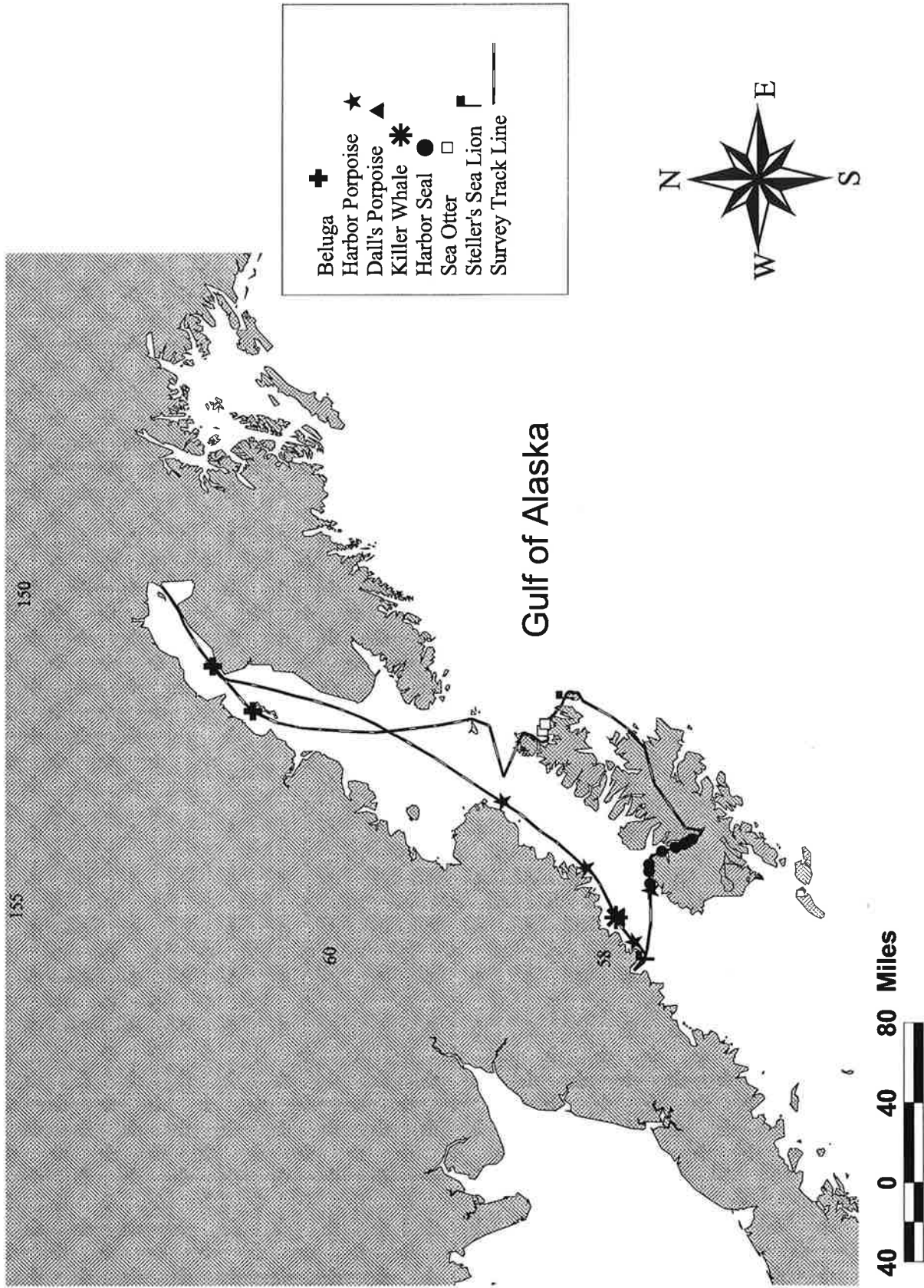


Figure B-10. Map of Flight 10 Survey Track and Marine Mammal Sightings 14 March 1997.

Flight No. 10: 14 March 1997. Weather was VFR for all of Cook Inlet and the Gulf of Alaska. In late March, the ice report showed young floe ice (1-3 and 5-7 tenths concentration) in parts of upper Cook Inlet, in Tuxedni Bay, and on the south side of Kamishak Bay (Appendix C, 31 March 1997). By early April, all of the inlet was nearly ice free (Appendix C, 7 April 1997). Flight #10 headed south down upper Cook Inlet to the East Forelands, where 10 beluga whales were seen, then headed southwest to the west side of Kalgin Island, where 9 belugas were seen (Figure B-10). Flight #10 continued south down Cook Inlet, through the Barren Islands, along the east coast of Shuyak, Afognak, and Marmot Islands, and into Kodiak for refueling. From there flight #10 crossed Kodiak Island to Uyak Bay and surveyed the bay. The flight headed across Shelikof Strait to Puale Bay on the Alaska Peninsula. The flight made one loop in Puale Bay, but high winds and seas made sighting impossible. The flight then headed north along the Alaska Peninsula coast to Cape Douglas, then up Cook Inlet back to Anchorage. A total of 19 beluga whales were seen.

Appendix C

**National Weather Service, Alaska Region, Current Cook Inlet Ice
Analysis: 22 November 1996 through 7 April 1997**

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SEA ICE ANALYSIS

DATE: FRI 22 Nov 1996

A-290

Confidence: Low

A = 8-10 YNG
B = 5-8 N/YNG

SEA ICE REG

- ICE EDGE
 - ESTIMATED ICE EDGE
 - FAST ICE
 - NEW ICE
 - YOUNG ICE
 - FIRST YEAR ICE
 - FIRST YEAR ICE THIN
 - FIRST YEAR ICE MEDIUM
 - FIRST YEAR ICE THICK
 - MULTI YEAR/ SECOND YEAR ICE
 - ICE CONCENTRATION (TENTHS)
 - ICE CONCENTRATION 1/10 OR LESS
- THICKNESS 0 - 10 CM
10 - 30 CM
> 30 CM
30 - 70 CM
70 - 120 CM
> 120 CM

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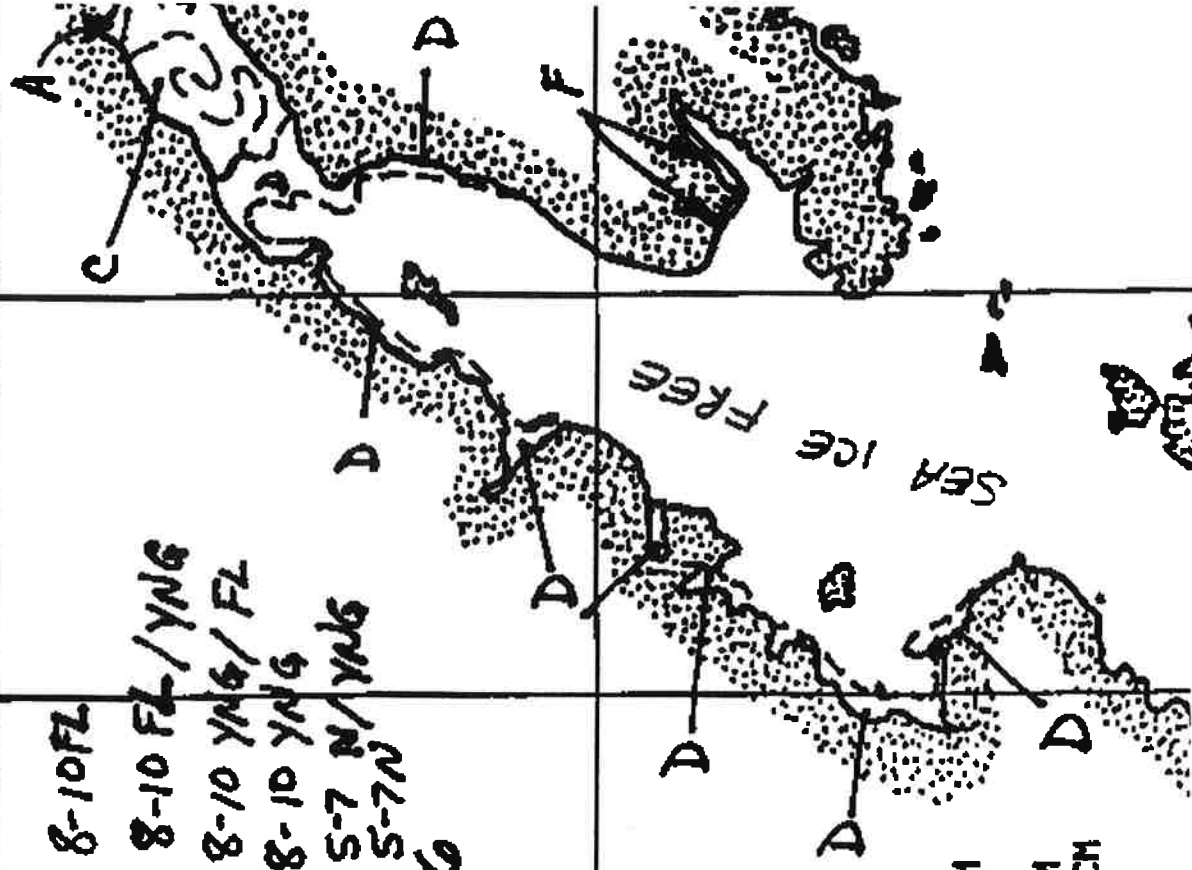
152

SEA ICE ANALYSIS

DATE: FRI 13 DEC 1996

A-290

Confidence: Low



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SEA ICE ANALYSIS

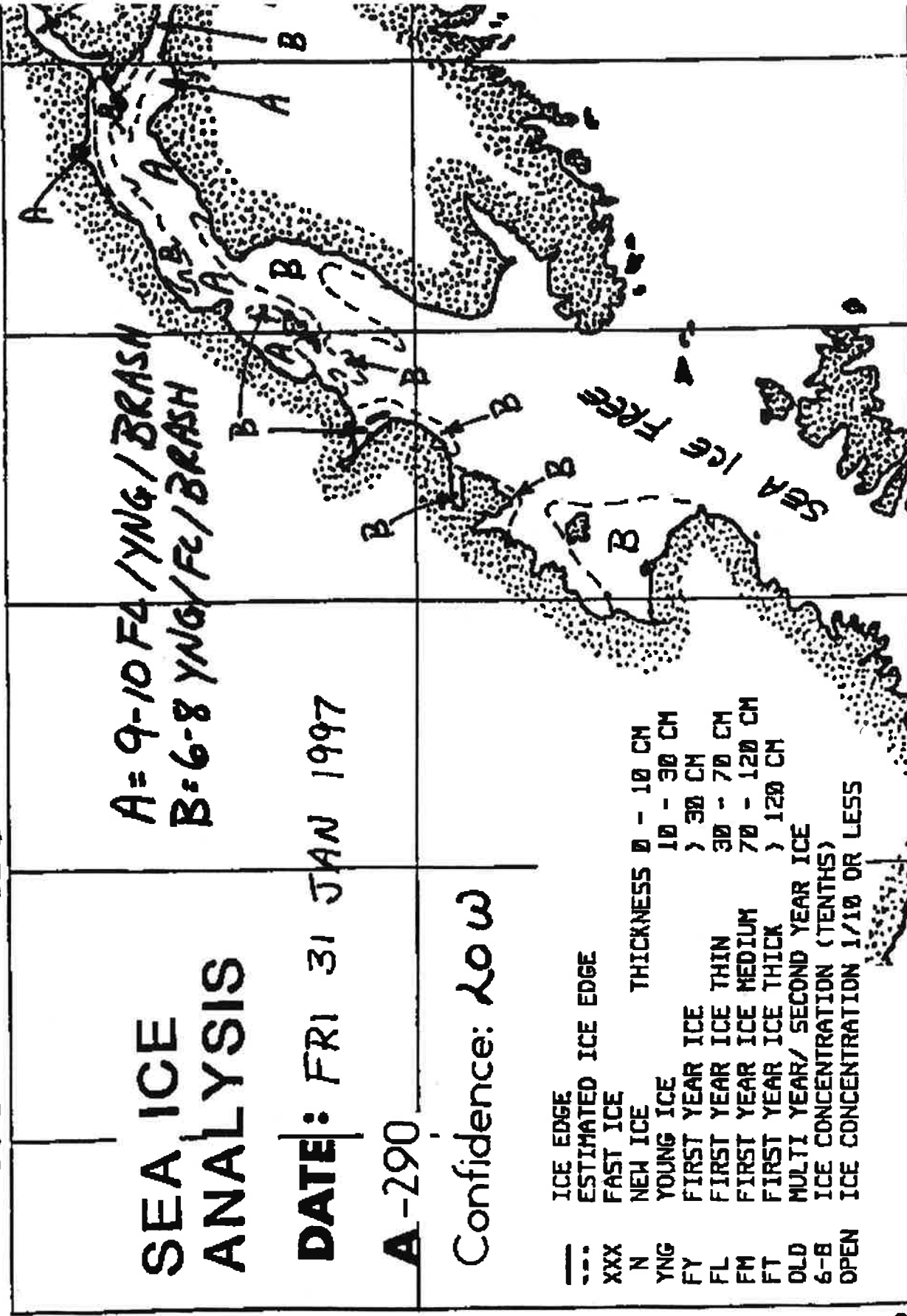
DATE: FRI 31 JAN 1997

A-290

Confidence: Low

A = 9-10 FL / YNG / BRASH
B = 6-8 YNG / FC / BRASH

---	ICE EDGE	
---	ESTIMATED ICE EDGE	
XXX	FAST ICE	
N	NEW ICE	THICKNESS 0 - 10 CM
YNG	YOUNG ICE	10 - 30 CM
FY	FIRST YEAR ICE	> 30 CM
FL	FIRST YEAR ICE THIN	30 - 70 CM
FM	FIRST YEAR ICE MEDIUM	70 - 120 CM
FT	FIRST YEAR ICE THICK	> 120 CM
OLD	MULTI YEAR/ SECOND YEAR ICE	
6-B	ICE CONCENTRATION (TENTHS)	
OPEN	ICE CONCENTRATION 1/10 OR LESS	



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SEA ICE ANALYSIS

DATE: WED 12

FEB 1997

A-290

Confidence: Low -
MODERATE

ICE EDGE

ESTIMATED ICE EDGE

FAST ICE

NEW ICE

YOUNG ICE

FIRST YEAR ICE

FIRST YEAR ICE THIN

FIRST YEAR ICE MEDIUM

FIRST YEAR ICE THICK

MULTI YEAR/ SECOND YEAR ICE

ICE CONCENTRATION (TENTHS)

ICE CONCENTRATION 1/10 OR LESS

THICKNESS 0 - 10 CM

10 - 30 CM

> 30 CM

30 - 70 CM

70 - 120 CM

> 120 CM

A=OPEN WATER

B=1-3 FL/YNG/BRASH/STRIP

C=8-9 FL/YNG/BRASH

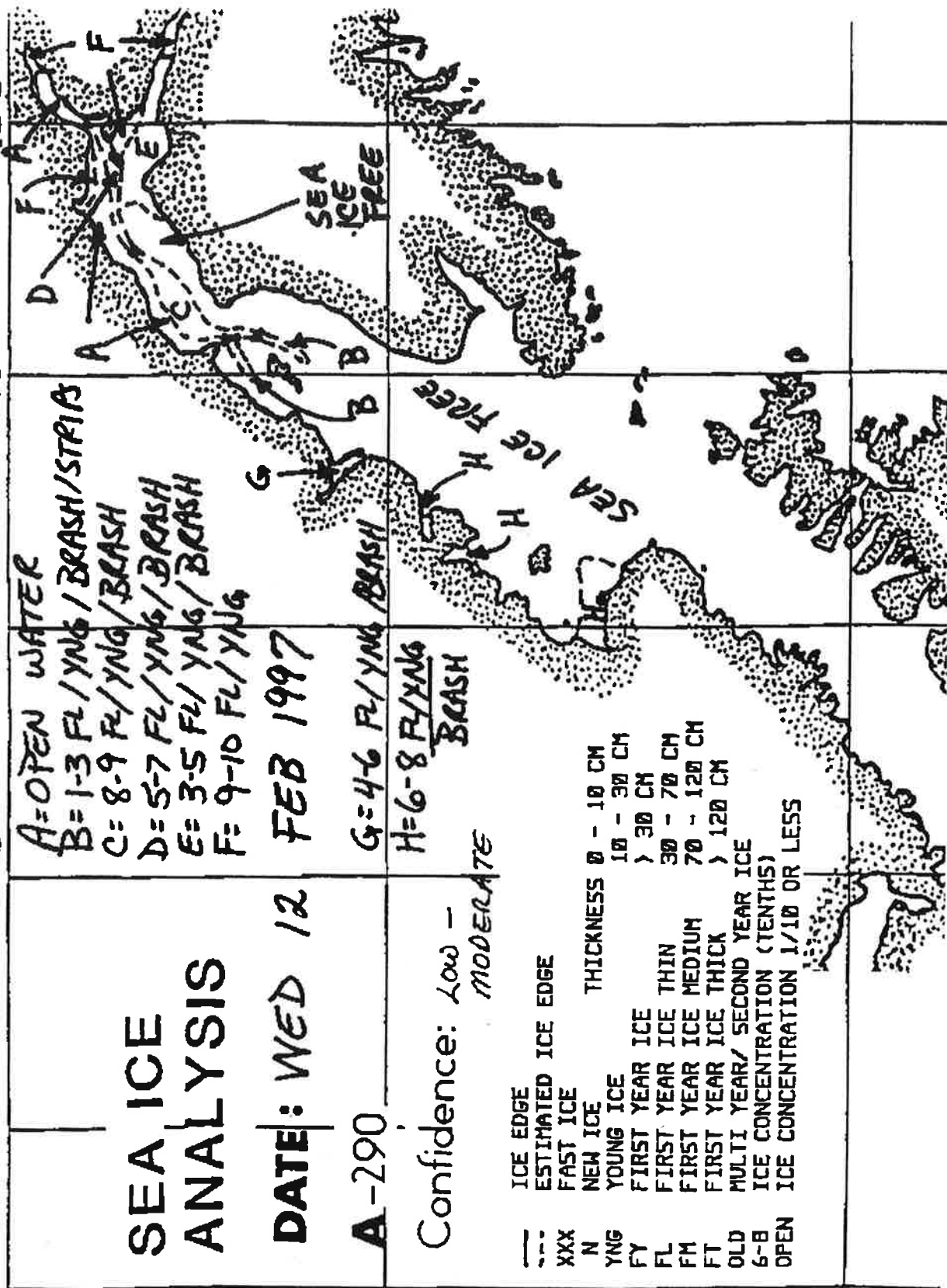
D=5-7 FL/YNG/BRASH

E=3-5 FL/YNG/BRASH

F=9-10 FL/YNG

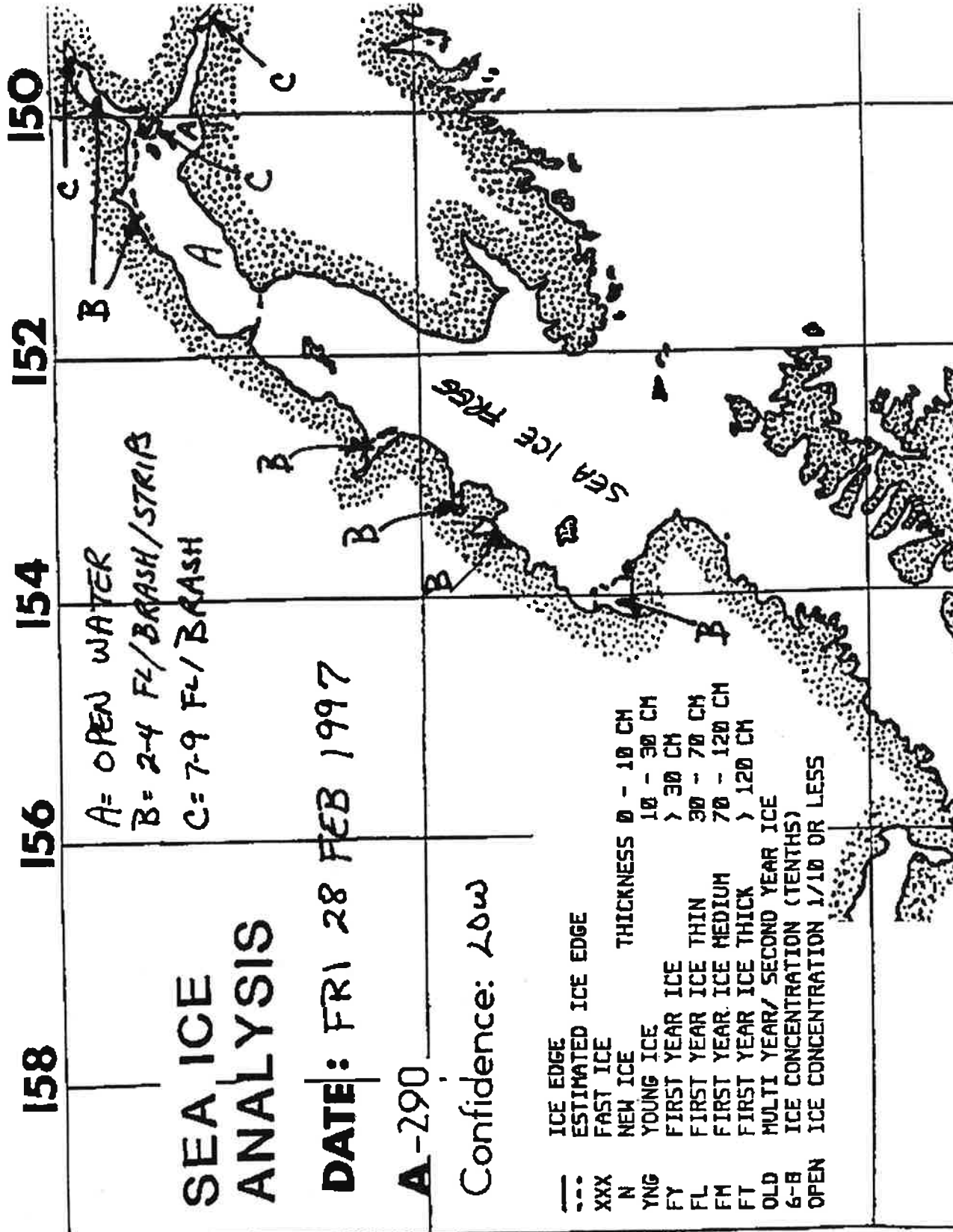
G=4-6 FL/YNG/BRASH

H=6-8 FL/YNG/BRASH



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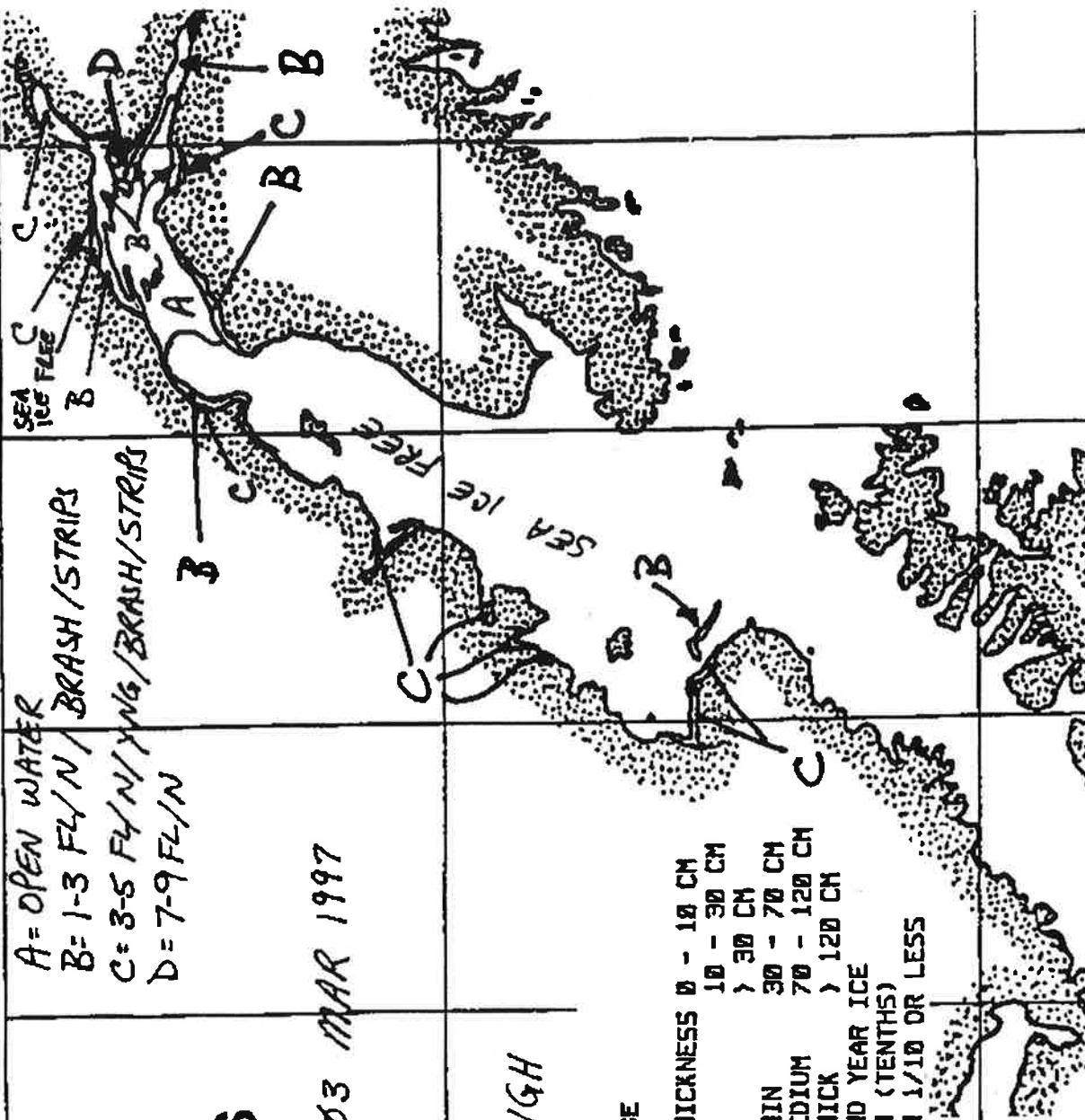
SEA ICE ANALYSIS

DATE: MON 03 MAR 1997

A-290

Confidence: HIGH

---	ICE EDGE		
XXX	ESTIMATED ICE EDGE		
N	FAST ICE		
YNG	NEW ICE	THICKNESS	0 - 10 CM
FY	YOUNG ICE		10 - 30 CM
FL	FIRST YEAR ICE		> 30 CM
FM	FIRST YEAR ICE	THIN	30 - 70 CM
FT	FIRST YEAR ICE	MEDIUM	70 - 120 CM
OLD	FIRST YEAR ICE	THICK	> 120 CM
6-B	MULTI YEAR/ SECOND YEAR ICE		
OPEN	ICE CONCENTRATION (TENTHS)		
	ICE CONCENTRATION	1/10 OR LESS	



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SEA ICE ANALYSIS

DATE: WED 12 MARCH 97

A-290

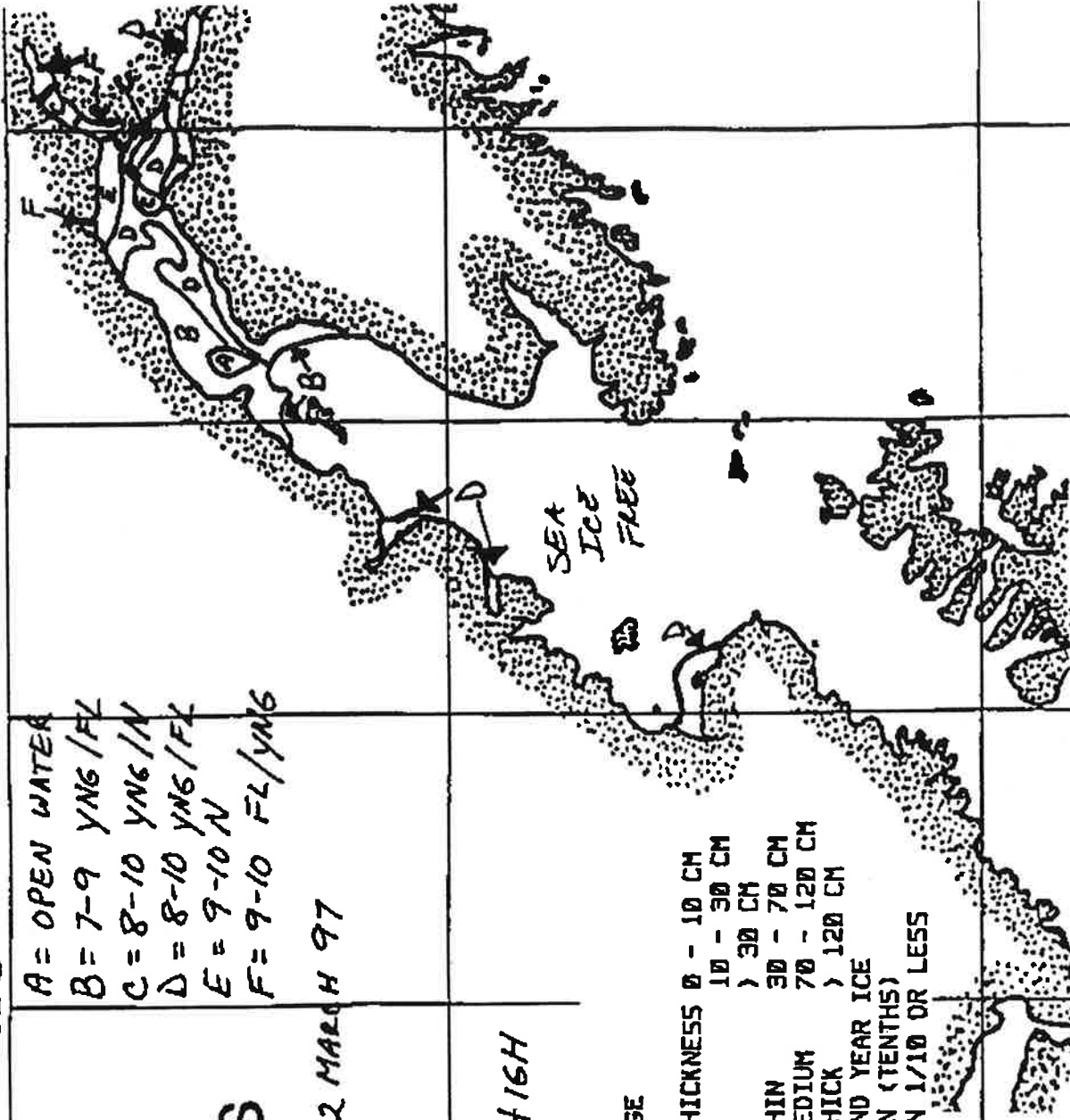
Confidence: H16H

ICE EDGE
ESTIMATED ICE EDGE
FAST ICE
NEW ICE
YOUNG ICE
FIRST YEAR ICE
FIRST YEAR ICE THIN
FIRST YEAR ICE MEDIUM
FIRST YEAR ICE THICK
MULTI YEAR/ SECOND YEAR ICE
ICE CONCENTRATION (TENTHS)
ICE CONCENTRATION 1/10 OR LESS

THICKNESS 0 - 10 CM
10 - 30 CM
> 30 CM
30 - 70 CM
70 - 120 CM
> 120 CM

XXX
N
YNG
FY
FL
FH
FT
OLD
6-B
OPEN

A = OPEN WATER
B = 7-9 YNG / FL
C = 8-10 YNG / N
D = 8-10 YNG / FL
E = 9-10 N
F = 9-10 FL / YNG



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SEA ICE ANALYSIS

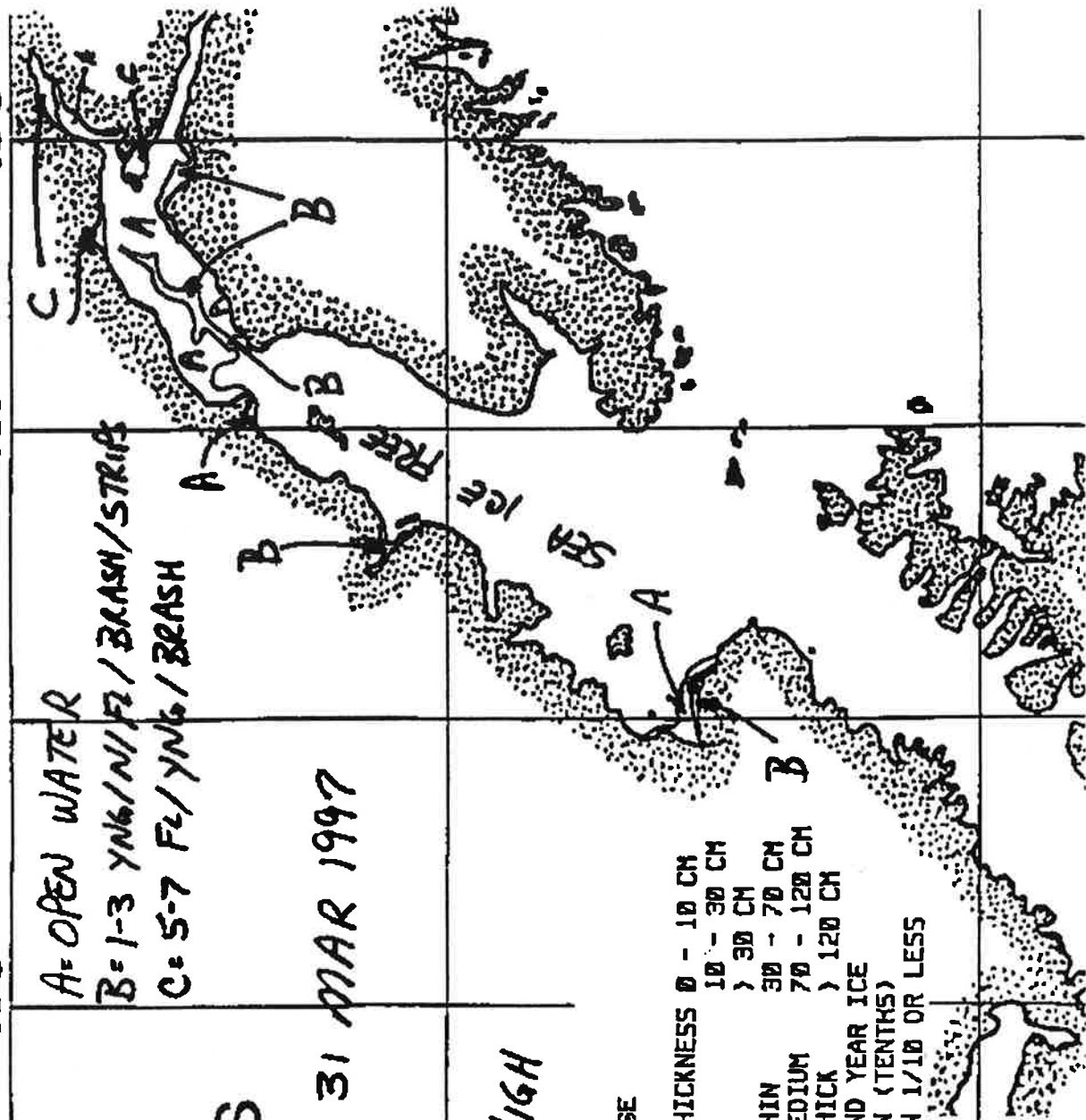
DATE: MON 31 MAR 1997

A-290

Confidence: HIGH

---	ICE EDGE		
---	ESTIMATED ICE EDGE		
XXX	FAST ICE		
N	NEW ICE	THICKNESS	0 - 10 CM
YNG	YOUNG ICE		10 - 30 CM
FY	FIRST YEAR ICE		> 30 CM
FL	FIRST YEAR ICE THIN		30 - 70 CM
FM	FIRST YEAR ICE MEDIUM		70 - 120 CM
FT	FIRST YEAR ICE THICK		> 120 CM
OLD	MULTI YEAR/ SECOND YEAR ICE		
6-B	ICE CONCENTRATION (TENTHS)		
OPEN	ICE CONCENTRATION 1/10 OR LESS		

A= OPEN WATER
B= 1-3 YNG/N/FZ/BRASH/STRIP
C= 5-7 FZ/YNG/BRASH



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SEA ICE ANALYSIS

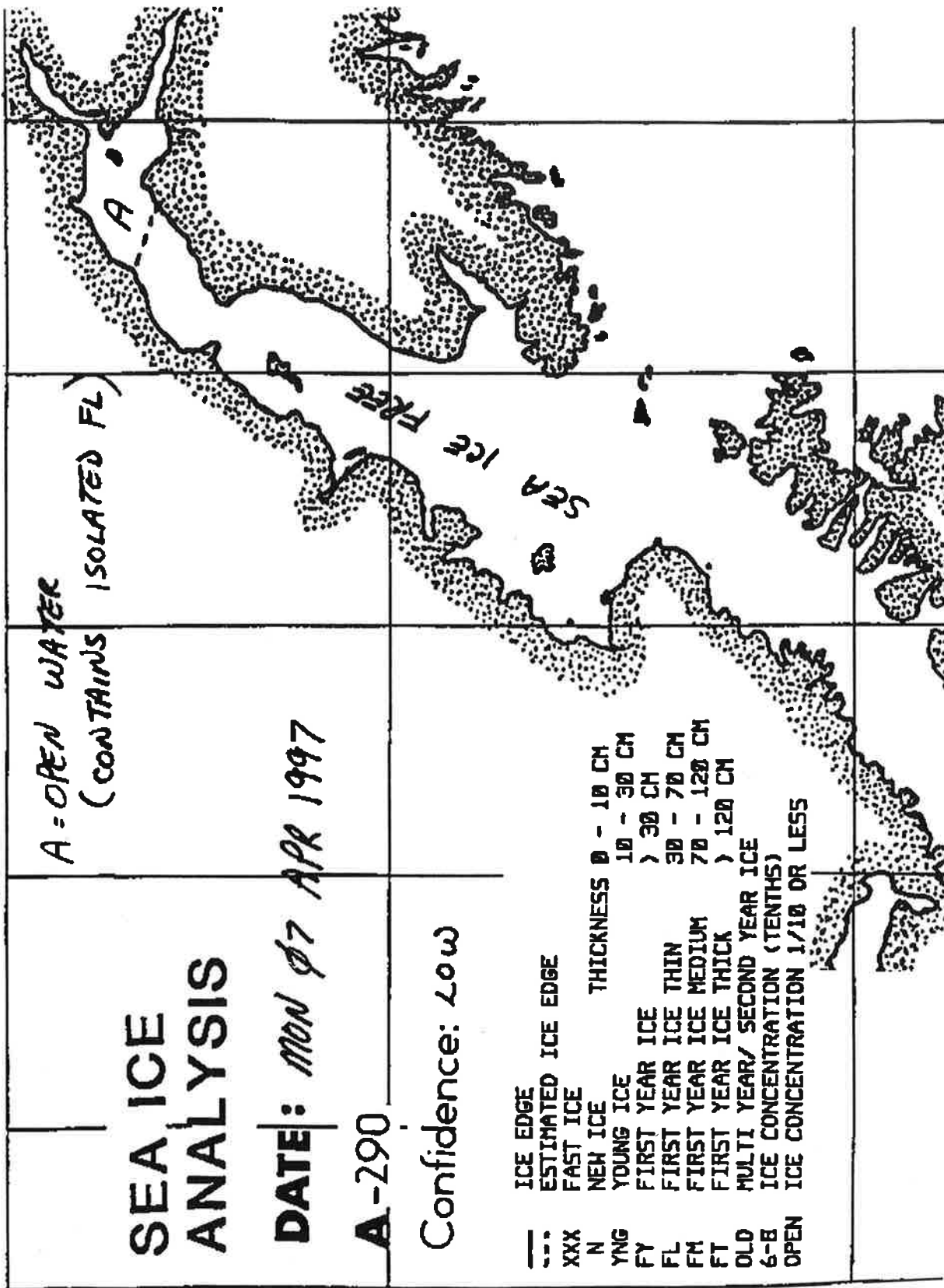
DATE: MON 07 APR 1997

A-290

Confidence: Low

A = OPEN WATER
(CONTAINS ISOLATED FL)

ICE EDGE	THICKNESS	0 - 10 CM
ESTIMATED ICE EDGE	10 - 30 CM	
FAST ICE	> 30 CM	
NEW ICE	30 - 70 CM	
YOUNG ICE	70 - 120 CM	
FIRST YEAR ICE	> 120 CM	
FIRST YEAR ICE THIN		
FIRST YEAR ICE MEDIUM		
FIRST YEAR ICE THICK		
MULTI YEAR/ SECOND YEAR ICE		
ICE CONCENTRATION (TENTHS)		
ICE CONCENTRATION 1/10 OR LESS		



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The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.



The Minerals Management Service Mission

As a bureau of the Department of the Interior, the Minerals Management Service's (MMS) primary responsibilities are to manage the mineral resources located on the Nation's Outer Continental Shelf (OCS), collect revenue from the Federal OCS and onshore Federal and Indian lands, and distribute those revenues.

Moreover, in working to meet its responsibilities, the **Offshore Minerals Management Program** administers the OCS competitive leasing program and oversees the safe and environmentally sound exploration and production of our Nation's offshore natural gas, oil and other mineral resources. The **MMS Royalty Management Program** meets its responsibilities by ensuring the efficient, timely and accurate collection and disbursement of revenue from mineral leasing and production due to Indian tribes and allottees, States and the U.S. Treasury.

The MMS strives to fulfill its responsibilities through the general guiding principles of: (1) being responsive to the public's concerns and interests by maintaining a dialogue with all potentially affected parties and (2) carrying out its programs with an emphasis on working to enhance the quality of life for all Americans by lending MMS assistance and expertise to economic development and environmental protection.